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CHANGING ENVIRONMENTS, CHANGING PEOPLES

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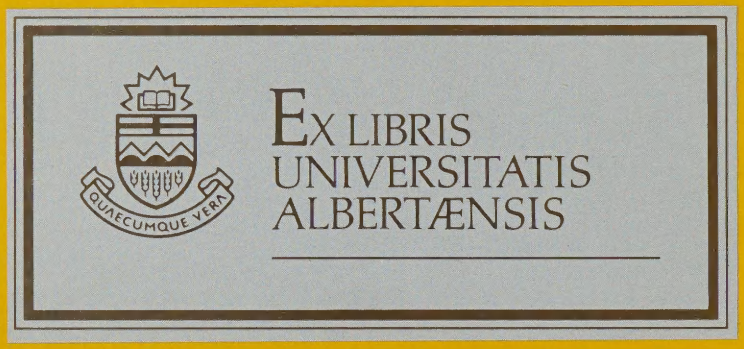
by Moyra Tooke

Background Readings
In Selected Global Issues

- **The vanishing rain forests**
- **Superdams, the search for hydro-electric power**
- **The rights of indigenous peoples**



Canadian Cataloguing in Publication Data

Main entry under title:

Changing environments, changing peoples

(Selected global issues)
For use in schools.
Bibliography: p.
ISBN 0-920766-03-X

1. Human ecology. 2. Rain forest ecology—Amazon Valley.
3. Dams—Environmental aspects. I. Tooke, Moyra.
II. Inter Pares (Firm) III. Series.

GF75.C48 304.2 C81-090007-6

Seminar 1. Selected Global Issues

CHANGING ENVIRONMENTS, CHANGING PEOPLES

Edited by Moyra Tooke
Developed by Inter Pares
Published by Teacher's Press Ltd. (Ottawa)

Distributed by
Fitzhenry & Whiteside Ltd.,
Don Mills, Ontario.

The Global Issues Series is a component of *The Common Heritage Programme*, a learning resource for teachers and students. *The Common Heritage Programme* is an exploration of contemporary environmental, social and economic issues from an international perspective. The Programme contains elements designed for all levels, primary to post-secondary.

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INTRODUCTION

Some geographical features of the world are so much a part of our mental picture of its general topography that we take them for granted — the Arctic regions for instance, seas and rivers, deserts and tropical jungles. Yet today's technology and the pressures of "progress" are literally changing the face of the earth. Development and exploration have already left their mark on the Arctic and changed the traditional life patterns of its people; the oceans, now becoming dangerously polluted, are the subject of intense international negotiations that will lead to their increasing exploitation for resources; most of the great rivers of the world have been dammed for hydro-electric projects or irrigation; the arid desert regions are increasing in size partly under stress of over-population; the tropical jungles are being cut down or burnt at a rate that will make them a geographical memory in only two decades from now.

What are the effects of these changes on the local and global environment? What, if any, are the rights of peoples, those indigenous societies whose cultures are being destroyed by massive environmental upheaval?

These basic questions are explored through examples based on jungle clearance in South America, massive hydro-electric projects around the world and an article on the growing international concern for the rights of native peoples.

The readings have been selected to give a background of information, to present a balance of viewpoints, and to lead to informed discussion. Additional reading and research will make for a richer and more rewarding presentation. It is hoped that students will look for relevant resource material in magazines, newspapers and other sources to add to an up-to-date resource file on the topics under discussion.

This booklet can be used as a basic resource for individual work on each of the three sections or as a total resource for a group seminar presentation on the overall topic of environmental and social development. Therefore, the questions are presented in such a way that they

a) help in a thorough review of the section and in developing work activities arising from it

b) lead to activities which make a logical contribution to the total group seminar.

The specific questions based on the readings in each section and found in the reader's guide should, therefore, be seen as the general foundation work for the seminar. General notes and suggestions on some of the ways the work can be presented are given with each series of questions.

This series of books, Backgrounds to Selected Global Issues, is less about facts than about ways of thinking about facts. The skills stressed are those of presenting a clear account of the issues raised, identifying their implications, and above all, formulating and defending considered judgements about them.

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I.

THE VANISHING RAIN FORESTS

It is estimated that roughly half the earth's forests have disappeared since 1950 and the bulk of the destruction has been in tropical zones. At this rate, more than two-thirds of the world's remaining rain forests may be gone by the turn of the century, scientists tell us. Is this "an unprecedented ecological disaster with economic consequences as serious as the oil crisis" — or is it, as others see it, the logical inevitable development of one of the world's last frontiers for agriculture and mineral resources?

1.

The Global Problem

A Canadian government expert presents a general analysis of the overall global problem of deforestation and explains some of the implications. The points he makes in this excerpt will be repeated in detail by other authors throughout the book.

Tropical moist forests are by far the richest ecological zone on earth. They are also the least explored by science: we now know more about certain patches of the moon's surface than we do about many parts of these forests. Furthermore, tropical moist forests are being over-exploited and generally degraded more rapidly than any other biome (ecological community). Many authoritative scientists believe that, by the end of the century, much of the biome will have been reduced to impoverished remnants — if not destroyed altogether. The present rate of destruction for the approximately 9 million km^2 biome is put, very roughly speaking, at somewhere in the region of 150 000-250 000 km^2 per year. True, many observers believe that by the year 2000 there will remain large blocks of little-disturbed forest (especially in the Zaire Basin and in the western sector of Brazilian Amazonia) and that substantial areas could survive until well into the next century. The actual rate of decline, and the prospects for the future, are matters of much controversy.

Also debatable is how much it all matters, and to whom. Who benefits from elimination of tropical moist forests, and how does it affect other people's hopes for a better life in other ways? Should we try to conserve the forests as an absolute end in itself, or should we begin to do what we can within a broader context of trying to improve long-term human welfare in all directions?

The decline of tropical moist forests will have many and varied consequences.

First of all, the tropical countries in question will lose a source of potentially renewable foreign exchange earnings. Their hardwood exports are now worth US $4.5 billion per year, and are growing at a rate far faster than that for international trade in all forest products. In fact, tropical wood exports now amount to about 4 percent of the value of all developing-world exports excluding oil, making it one of the

five most important export commodities produced by the developing world. At the same time, the main markets for tropical hardwoods, affluent nations — will lose the prospect of sustainable supplies of specialist timbers.

Secondly, elimination of these forests can trigger an "ecological backlash", both at a local and global level. Especially important are watershed repercussions of deforestation. Forty percent of developing-world farmers live in valleylands and so depend heavily on the "sponge effect" of forests in surrounding catchment areas. When forests disappear, rainy season supplies of water tend to be released in floods, followed by months long droughts. In parts of Southeast Asia, the Green Revolution is losing momentum as farmers find they can no longer look for regular supplies of irrigation water for their multiple crops: soil erosion is causing sedimentation of water reservoirs and hydropower installations. Reservoirs in the Philippines, Pakistan, Ecuador, and Colombia are now estimated to be losing their capacity within half their projected life spans. Similarly, the Panama Canal is filling up with washed-off soil from eroded watersheds, making it less able to handle outsize cargo ships. In Thailand, waterways that once provided an energy efficient transportation network have become too choked with silt debris to be navigable. Now that additional deforestation-caused troubles, notably disastrous floods, are spreading to broad sectors of Thailand, the government has decided to use extraordinary powers of summary judgement, even execution, to punish unauthorized cutting of forests. . . .

From the standpoint of interdependency within the global community, some further, and ultimately more important, issues arise. Were tropical moist forests to be largely eliminated, the process could have a major impact on world climates. . . .

These climatic consequences are scarcely more important than the impending loss of a large portion of the earth's stocks of species. Of the 5-10 million species that are believed to exist on earth, as many as 40-50 percent are thought to live in tropical moist forests. The next few decades could see the elimination of at least one million species in these forests, conceivably many more. It is not unrealistic to suppose that we are losing at least one species per day right now. Aesthetic and ethical arguments aside, there are strong economic factors in favour of safeguarding species . . .

To consider agriculture first, tropical moist forests have supplied the origins of many staple foods, notably rice, millet, cassava, pigeon pea, mung bean, yam, taro, banana, pineapple and sugarcane, to name but the better known. A huge cornucopia of other foods waits to be investigated. In Indonesia alone, some 4 000 plant species are thought to have proved useful to native peoples as food of one sort or another, yet less than one-tenth have come into wide use. At least 1 650 plants of tropical forests offer highly nutritious leaves.

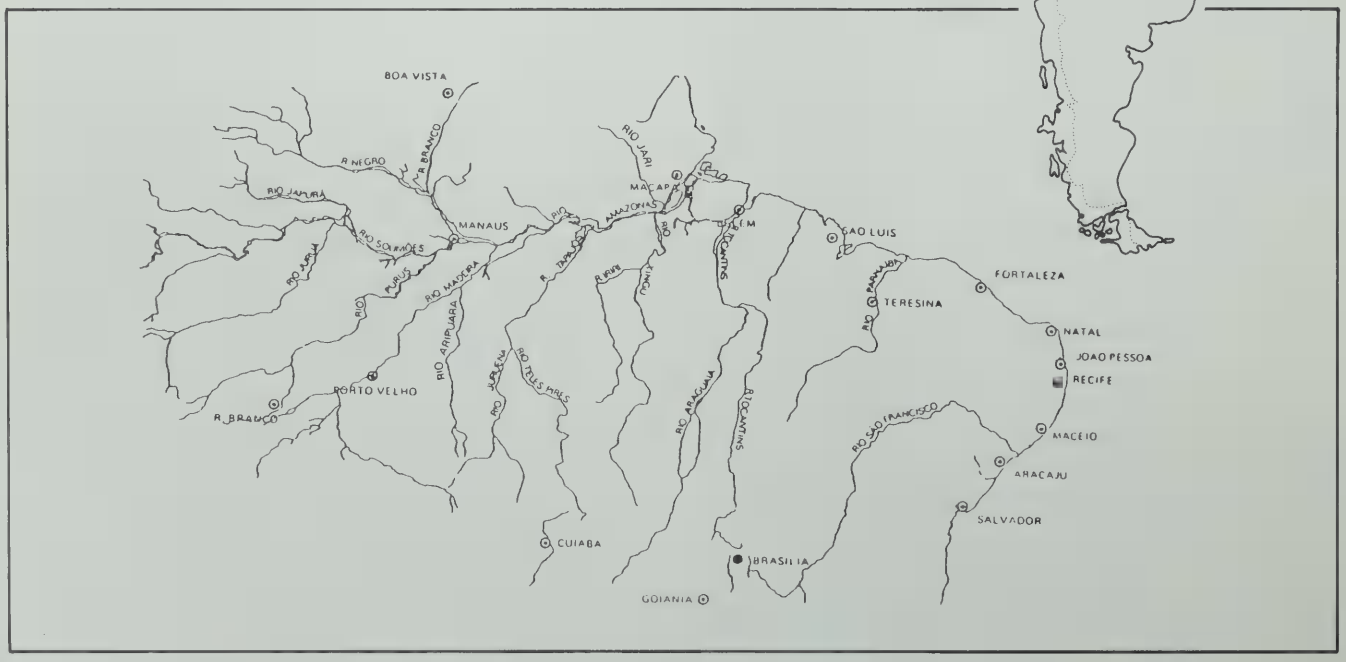
Moreover, tropical moist forests contain many wild relatives of modern food crops — crops that, being the refined products of genetic engineering, require constant "topping up" with fresh germ plasm in order to resist new types of diseases and pests, environmental stresses, and the like, as well as to increase productivity and nutritive content. During this century, genetic resources from tropical forests have saved a number of important crops, including bananas, sugarcane, cocoa, and coffee. To give an idea of the economic values involved, groundnuts worldwide have suffered from leaf-spot diseases — a problem that proved surmountable through resistant varieties from wild forms in the rain forests of Amazonia, among other areas.

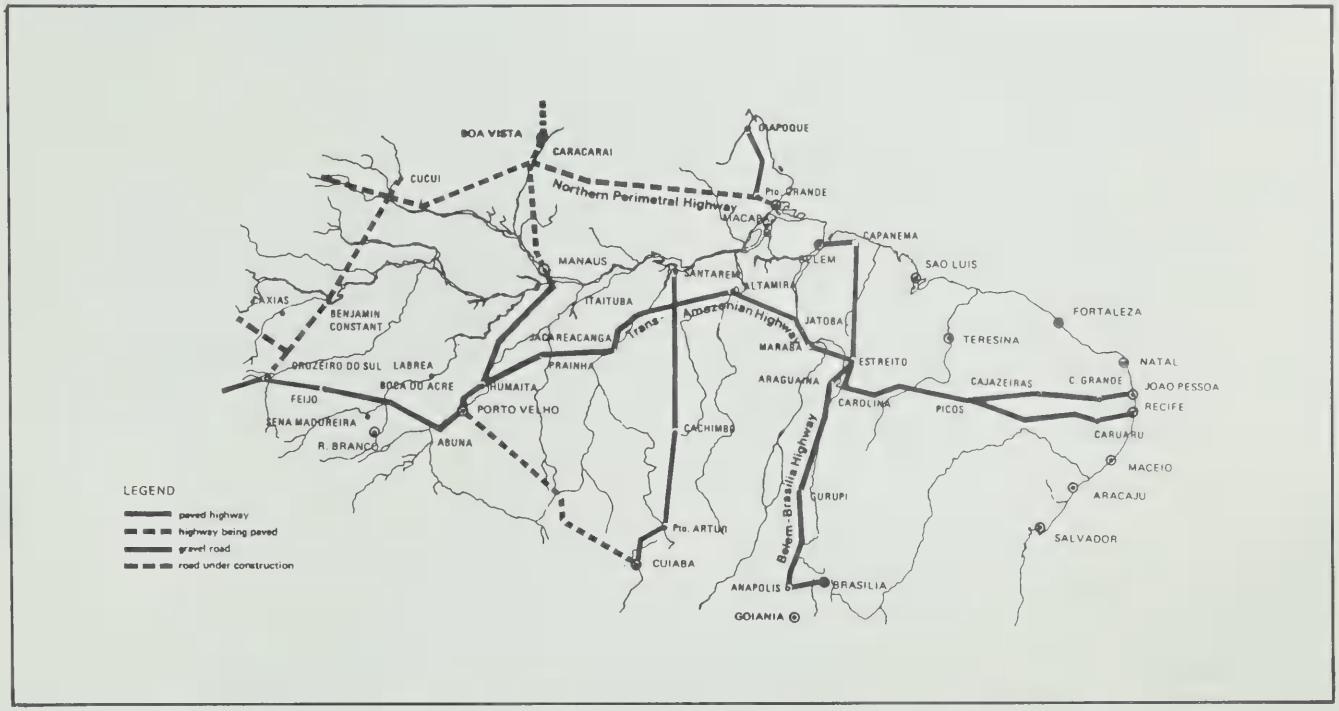
From: *We All Gain or Lose Together*, Norman Myers, 1979

2.

The Development of Amazonia

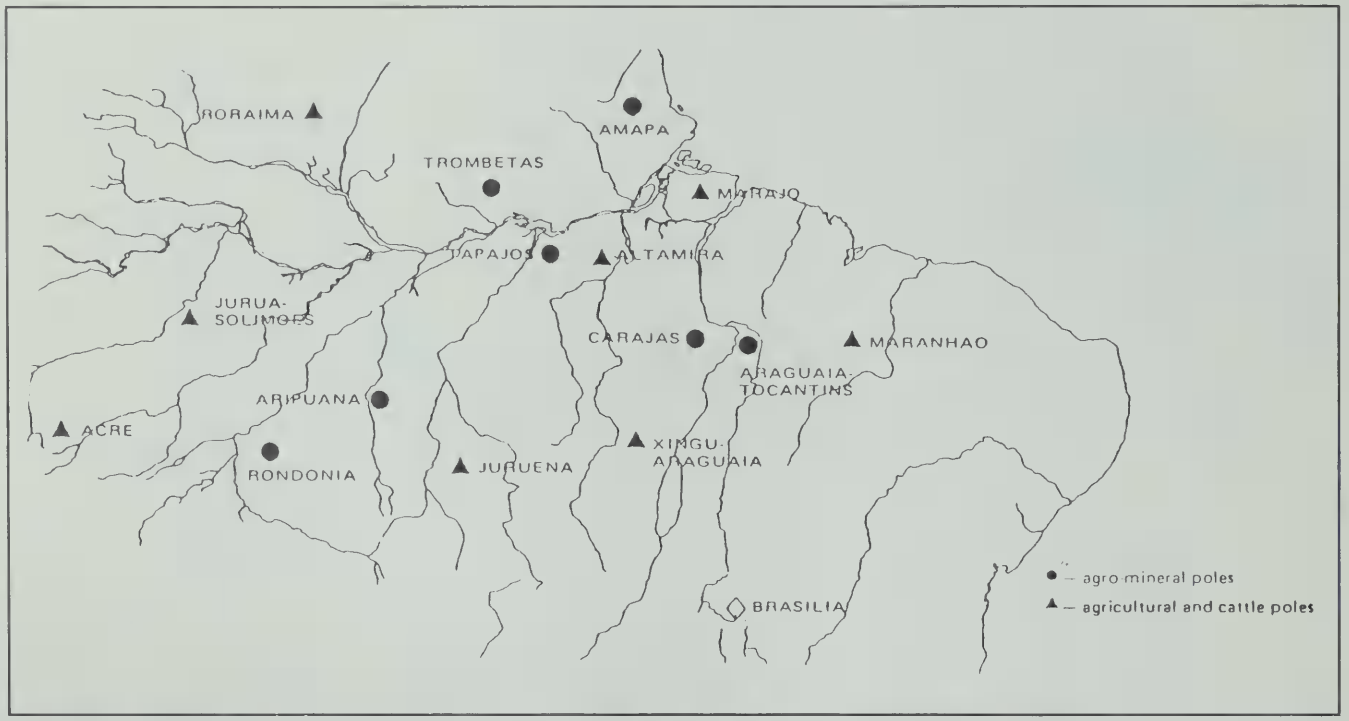
Amazonia is a vast territory lying north and south of the Equator and covering more than 40 per cent of the total land area of South America and more than half the land area of Brazil. Through it flows the world's largest river and a complex network of more than 1,000 tributaries large and small. At any time the Amazon and its tributaries contain two thirds of all the river water in the world, and 17 of the Amazon tributaries are more than 1,000 miles long.





Roads to development . . .

The river is now being supplemented as a means of transport by a new network of roads through the forest. The roads will bring industry and population to the empty areas of Amazonia.



POLAMAZONIA

Development will be fostered by concentrating on certain centres or 'poles' of development at strategic points in the Amazon Basin. These poles, chosen for their natural advantages as centres of industry, mining or agriculture are expected to act as sources from which development will spread outwards into neighbouring regions.

3.

Science and The Amazon

Brazil has a large population living in poverty in the drought-ridden exhausted land of the northeast. The promise of millions of hectares of untouched new land with promise of new resources for the national economy, was hard to resist. This article from a Brazilian government publication shows that the development of the Amazon rain forest, whatever its effects may be, was not begun without planning or concern.

The rain forest of the Amazon is one of the World's most ancient, enduring and complex ecosystems. The evidence of fossils suggests that it may have existed almost unchanged for 60 million years. Ice Ages and climatic change in the past have of course shifted the boundaries of the forest, and the processes of evolution have altered its population of plants and animals, but its major features have not changed appreciably for millions of years.

Tropical rain forests like the Amazon differ in many ways from forests found in temperate lands. They differ also from the preconceptions of those who have never visited them, or have only skirted their edge. First, they are not alive with animals: it has been found that the living mass of plants in a hectare of the Amazon rain forest amounts to 900 tonnes, but the animals occupying the same area would weigh a mere 0.2 tonnes. Nor is the Amazon rain forest a dense and clinging mass through which it is impossible to cut a path. At ground level in the middle of the forest there is comparatively little undergrowth because the tree cover above is so complete that light cannot penetrate in sufficient quantity to encourage growth. Along rivers and roads — the view most outsiders have of the forest — the undergrowth is denser because light can penetrate through the canopy. The most common fallacy is that the density and richness of the forest are evidence of fertile soil beneath it. In fact, the roots of the trees in the Amazon forest seldom penetrate more than a few feet beneath the surface, and often trees are supported as much by the clinging lianas which stretch from tree to tree as they are by their roots.

The rain forest is not a single environment, but several. Species which thrive at the top of the tall trees, exposed to sunlight and breezes, are quite different from those which live on the forest floor, insulated by the dense canopy from the daily changes of temperature. Professor Paul Richards, an expert in the botany of tropical rain forests, has commented that the environment of the forest floor rivals a cave or a laboratory growth room in the constancy of its conditions. As a result, the life of the rain forest is divided horizontally into a series of bands. Many of the species, like butterflies, birds and frogs, which flourish in the treetops never descend to ground level. Different species of insect are found at different levels in the forest, and the animals of the tree-tops, adapted to a life of swinging from tree to tree, are totally different from those on the forest floor.

One of the rain forest's most remarkable characteristics is the variety of tree species it contains. While a temperate forest would have no more than 10 to 20 different species of tree in an area of 5 acres, the Amazon rain forest can have as many as 100. The distance between neighboring trees of the

same species may often be considerable; so that instead of seeing a group of similar trees together, the visitor to the forest will identify a species and then have to search for many hundreds of yards to find another. The reason for this curious distribution is still a matter of dispute. In a temperate forest, soil conditions and climate vary sufficiently from place to place to favour one species over another. As a result, trees often tend to grow in groups of the same species concentrated in an area to which they are particularly well suited. . . .

One of the Amazon's curious mysteries is how such rich vegetation can grow in such infertile soil. One reason is that the factors limiting growth in temperate forest — low temperatures, inadequate rainfall and short growing seasons — are absent in the rain forest. Growth can go on continuously, rainfall of more than adequate and low temperatures are rarely encountered. But this still fails to explain how huge trees can grow from soil which contains so few of the essential nutrients. The paradoxical explanation is that the nutrients are in the trees themselves, not in the soil. When leaves and dead wood fall to the ground they are quickly decomposed and the minerals they contain immediately recycled back into the tree by the roots which lie close to the soil surface. Thus although the total amount of plant nutrients available at any time in the rain forest is limited, it is all being used in an endless cycle. Because of the rapidity with which fallen leaves are used again as food, no depth of soil has ever been formed beneath the trees. And because the nutrients are permanently 'locked up' in the trees, the Amazon water washes away very little plant nutrient.

The Amazon rain forest is thus an environment which is rich in rainfall and light, and has a favourable year-round climate, but which has had to devise finely-balanced systems to make best use of its limited plant nutrients. In this it compares favourably with most modern intensive farming, which is obliged to use large quantities of fertiliser — so much fertiliser, in fact, that the run-off from the fields frequently poisons rivers and lakes. Where man has interfered with the forest and this delicate machine has broken down, severe ecological damage has followed. So when the Brazilian Government began the construction of the Trans-Amazonian Highway in 1970, admiration for the boldness of the step was tempered by fears that the forest would be damaged beyond repair. Most anxiety was felt for the conservation of the soil, once it had been stripped of its tree coverage. The unplanned deforestation of an area which is subject to short periods of torrential rain would cause serious erosion and the leaching of the soil, which would rapidly become unproductive. If this were to happen, the whole of Amazonia might become a desert or an area of poor scrubland able to support only subsistence farming.

A second fear was that the forest might prove essential for the ecological balance of the area. An area which for centuries has been covered with dense virgin forest cannot be cleared without serious environmental and climatic consequences. These anxieties were expressed both in Brazil and abroad, and were not merely a matter of concern to scientists and those interested in environmental problems. They were a matter of concern above all to the Brazilian Government itself, which had already had experience of the gravity of the problem in a small area which has been cleared of forest in the stretch between Belem and Braganca along the highway. This area is known as Bragantina. It covers some 12,000 square miles and was colonised at the end of the 19th century by immigrants from the North-East of Brazil. The purpose of the colonisation was to provide the growing city of Belem with food. Areas of forest were cut down and foodstuffs such as beans, rice, manioc and corn were planted. After a couple of years the fertility of the first clearings was exhausted, and the farmers moved further into the forest. Each freshly-cleared area provided two or three good harvests before the soils were exhausted and the farmers had to move on.

By 1950 all the original forest had gone and the cycle began again, with farmers clearing land which had been farmed once and had returned to semi-forest conditions. But removal of this secondary growth brought only one successful harvest. The Bragantina experiment has not been successful; it did not provide food for Belem and the Government is now anxious to move people out rather than encourage them to go in.

But the failure has been studied as an example of what not to do in future. The studies have concluded that the felling of the trees was done indiscriminately, by reckless migrants untrained for new kinds of agricultural activity. They were unsupervised, because the Belem-Braganca highway was only a short stretch of road and not part of a development plan for the whole area. In addition, the successive use of fire to clear land for growing subsistance crops impoverished the soil, producing the so-called *capoeiras,* areas where only small trees will grow. To avoid making the same mistakes again, the Brazilian Government employed experts to carry out studies in depth into the problems, and enacted careful legislation which lays out a conservationist policy for the forest. This aims to maintain at least a 50 per cent coverage of forest in areas that are developed, and to leave large areas untouched as parks, forest reserves, and animal reserves.

The Amazonia National Park in the state of Para has already been established, covering one million hectares. Further parks are to be established when the results of the survey of the forest are complete. In addition, a series of animal reserves have been set up . . .

In areas which have already been settled, the legislation allows the financing of projects only if they leave 50 per cent of the forest cover intact. Experiments are being carried out with a number of crops which may be suitable for protecting the soil against erosion in areas which have been cleared; sugar cane, grass and soya are all possibilities. In addition, the policy encourages settlers to replant the forest with selected soft-wood trees suitable for the production of wood-pulp for paper. One such project, at Jari, is already giving good results.

But the Brazilian Government would be the first to admit that more research will be needed before it is fully understood how Amazonia can be developed without destroying it. This is why the Government has decided to build a scientific city on the banks of one of the Amazon's tributaries, the Aripuana. The scientific city of Humboldt will become the laboratory of Amazonia, carrying out studies of engineering, architecture, town planning, medicine, basic sanitation, transport, agronomy, forestry and fisheries.

From: A publication of the Brazilian government, 1972

4.

The Rape of Amazonia

This excerpt is from an article written by a journalist whose concern for his subject is evident in every line. A clear comparison in style can be made with the objective, scientific approach of the previous article. Look for some of the words or phrases that indicate this author's attitude.

The Amazon forest leaves its mark on the imagination of all who see it. It is one of nature's exaggerations, matching the great river, which viewed across white beaches, the further bank out of sight, could be an ocean drifting eastwards.

One third of the world's trees grow in the forest's five million square kilometres — an area larger than Europe. It extends its umbrella of shade over half Brazil; the cool, damp, crepuscular corner of a continent. It is shown as blanks on the map between the veining of rivers and has little legend and no history. . . .

The trees provide the final refuge of 100-odd Indian tribes, numbering perhaps 40,000 people. It is believed that almost as many have disappeared since the turn of the century — many as the result of outright murder, more through the white man's diseases, against which the Indian has no immunity. Occasionally a new Indian group is found — flushed out of the trees by pioneers who cut the trails ahead of the road-building gangs — and when this happens about a quarter of those 'contacted' can be expected to die of one commonplace Western ailment or another within the year. Indians are entirely dependent upon the forest. They cannot survive outside it.

By the 1970s about a quarter of the forests of the Amazon Basin and Mato Grosso had already been destroyed. Eleven million hectares of trees had been cleared in the preceding decade alone, and it became a matter of simple arithmetic, if this were allowed to go on, to forecast a date when the forest would cease to exist altogether.

Most of the clearing was done by foreign enterprises such as Daniel Keith Ludwig's Jari Forestry and Ranching Company, the Italian firm Liquigas, Volkswagen do Brasil, and King Ranch of Texas. These and many more had been encouraged in their attack on the forest by financial incentives offered by the Brazilian Government. Great fires — some of them ignited by napalm bombing — raged all over Amazonia, consuming trees by the hundred millions, and for months on end travellers on planes on their way from Belém to Manaus or Brazilia saw little of the landscape beneath them through the smoke. . . .

With the growing suspicion that the multinationals were little concerned with the long-term problems of the nation,

voices were raised to inquire whether this rape of the forest, so apparently devoid of economic reward, might not in the long run have some undesirable effect on the climate. The mild obsession, familiar in northern latitudes, over the possibility of the return of the Ice Age is replaced in the tropics with a conviction that the reverse is likely to happen. In Peru a loss of permanent snow has been recorded from the Andean ice-peaks. Bolivia has suffered from declining rainfall and searing winds, while in Brazil itself parts of the north-east in the area of Ceará have been reduced to near desert.

These misgivings were given alarming substance by the publication of figures based on 17 years' field studies in Amazonia. This research was done by Harald Sioli, Director of the Max Planck Institute of Limnology, in West Germany, and his calculations showed that the Amazon forest contributed through photosynthesis 50 per cent of the world's annual production of oxygen. He argued that it could not be sacrificed without a dramatic if not fully predictable deterioration in world climate. He calculated that the forest contained about 300 tons of carbon per hectare, and that its total extension of 280 million hectares, if burnt down, would allow sufficient carbon dioxide to be released into the atmosphere to cause a 10 per cent increase of the gas. The threat was two-fold; the loss of the forest's important contribution of oxygen, and of its capacity to absorb carbon dioxide. Sioli noted that the burning of fossil-fuels had already caused a 15 per cent increase in carbon dioxide over the past century, and that the forests were failing to contain the increase. He concluded that destroying the Amazon forest would be like getting rid of one of the world's major oceans — environmentally suicidal.

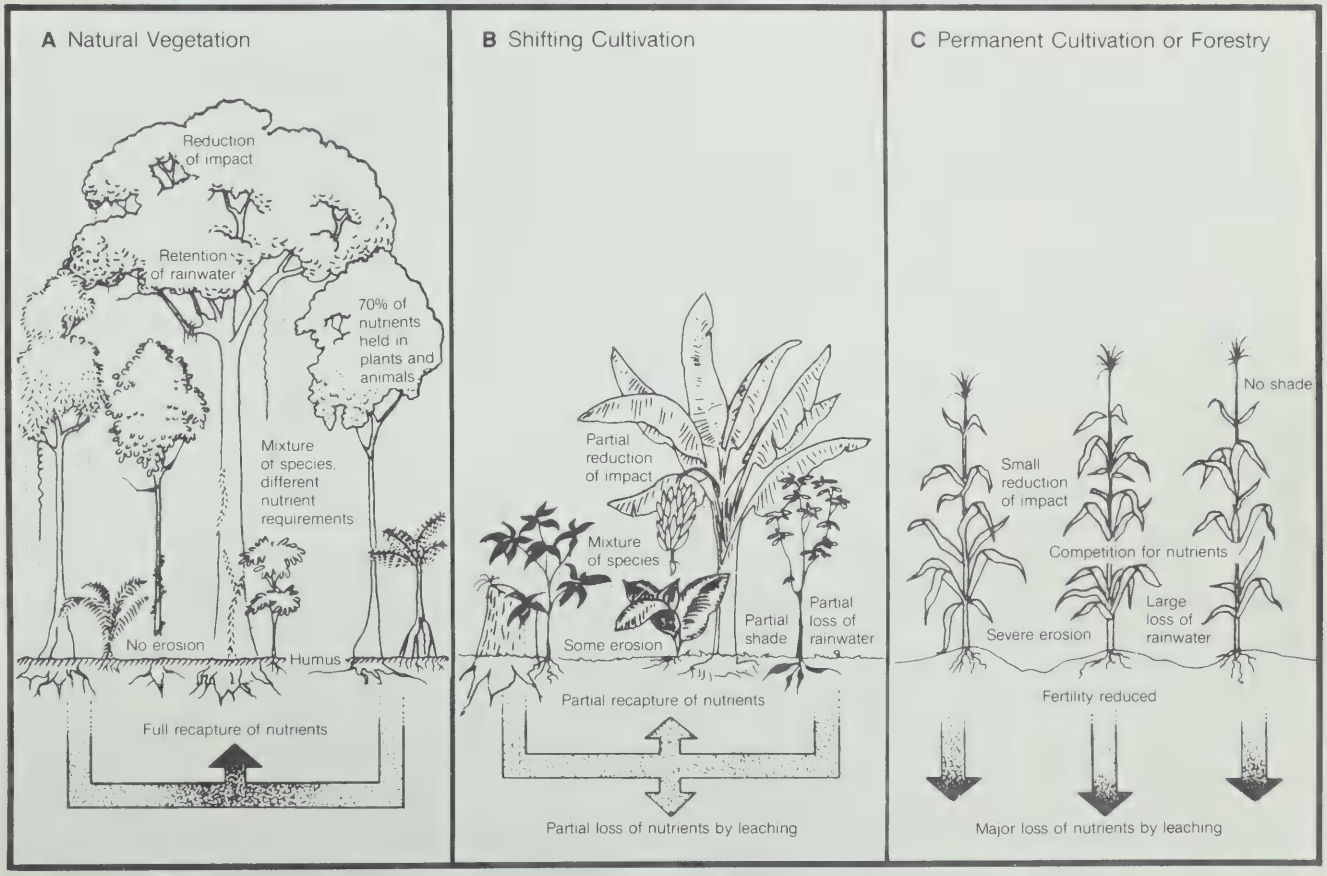
There has been some scientific bandying of arguments over these figures, which have been wholeheartedly endorsed by some experts and received with caution by others. One climatologist, for example, has argued that one third of the carbon dioxide released by burning fossil-fuels remains in the air, while another believes that the proportion is two-thirds. These are matters for discussion . . .

Enear Salati, professor of physics and researcher in agriculture at the University of Sao Paulo, was quoted in *Critica* of Manaus as saying that the destruction by burning of the Amazon forest, and consequent increase in the carbon dioxide content of the atmosphere, could result in heightened world temperature, the melting of the polar ice-caps, and a sufficient rise in ocean levels to bring about the inundation of hundreds of coastal cities throughout the world . . . .

The threatened forest offers the paradox of an area into which is crammed the greatest abundance and diversity of living things to be found anywhere on earth, yet is potentially a desert. Only the thinnest skin of humus covers the laterite floor. Apart from what is derived through photosynthesis, the trees live almost by what can be described as self-cannibalisation, upon nutrients furnished by the litter they themselves provide, made rapidly available through the action of insects, worms and fungi. The forest recycles 51 per cent of the rain that falls on it, and produces little more energy than it consumes. It lives then, almost independent of the soil, in a state of equilibrium.

Remove the trees and the average temperature of the area where they once stood increases by 30° F, rainfall declines sharply (by five per cent per year over the last 10 years in some areas recently deforested in neighbouring Bolivia), yet flooding becomes a recurrent hazard, because with the loss of the 'sponge effect' of the forest's root-mat, the soil can no

Clearing the Forest: A Catastrophe?



longer contain the excess of water. With the rains, such nutrients as the forest floor contained are instantly washed away, and the laterite, laid bare to the sun, oxidises and loses every trace of fertility. This is no equatorial replay of the slow process of the formation of dustbowls in ruined, US prairies: this is instant desert unless immediate and costly counter-measures are taken . . .

Where the destruction of trees threatens a commercial resource, the government is sometimes moved to act. In the province of Acre, where the worst deforestation took place, 10,000 Brazil nut-gatherers had lost their livelihood and only a handful of them could find work on the new ranches. A law was therefore passed prohibiting the cutting down of the *castanheiras*. But forest fires are not selective, and as before, the nut trees went with the rest. Where it was possible to leave one standing in isolation it was soon found that such solitary survivors failed to produce nuts. It was discovered that without the presence of certain insects the pollination of their flowers could not take place, and the pollinators had gone with the rest of the forest. Even had nuts been produced, such trees could not have increased their numbers, because this called for the cooperation of a species of rodent, also defunct, which had been programmed by evolution to chew the hard coating off the nuts, and distribute them in places suited to their germination.

These recently discovered mechanisms responsible for the production of the Brazil nut provide a clue to the dimensions of our ignorance of the workings of the forest.

The approach of Doomsday for the Amazon forest was signalled by the launching of the great road-building programme of the early 1970s intended to slice it into easily accessible segments. This enterprise, undertaken in haste and with small forethought, followed a visit in 1970 by President Medici to the chronically distressed north-east, at that time proclaimed a disaster area after one of the worst droughts in its calamitous history.

. . . the desperate need of the country's many poor

The President promised, in effect, to spirit these wretched people away from their dour surroundings and deposit them in sylvan glades of Amazonia, where they would receive 100 hectares of land apiece. Along the new highways he proposed to build low-cost but cheerful housing, and supply credits and facilities of all kinds, and thus they would be encouraged to lay the foundations of new and fruitful lives.

As a safety-valve for the chronic poverty of the north-east the project was a failure. The intention had been to settle five million peasants in Amazonia by 1980, but after two years only 100,000 had come and many of them were already beginning to slip away back to the badlands they had left.

Like poor city dwellers induced to leave the companionable slums for the aseptic planning of a garden suburb, they soon yearned for the familiar squalor they had left. They lacked the energy and the improvising genius necessary to come to terms with soil that produced two crops — three at most — before giving up the ghost. Rain, the greatest of all blessings in the north-east, was now the enemy. Life had to be shared with a multitude of stinging insects; new sicknesses defied the familiar remedies, and there were snakes in the back garden. Thus the planning floundered and collapsed, leaving Amazonia littered with destitute homesteaders . . . .

Brazil abounds with vigorous and articulate conservation groups, but they are powerless in the presence of one crushing fact: the desperate need of the country's many poor. In January *O Journal do Brasil* published figures showing that in Rio de Janeiro alone 918,000 people were living in 'absolute poverty', and in the city's total population of nine millions, 27 per cent lived in 'relative poverty'. These are the statistics that blunt conservationist scruples. There is a constant pressure to develop more sources of food, joined to an irrepressible belief that sooner or later a way will be found to turn the relatively unproductive five million square kilometres of the Amazon Basin into a bottomless larder.

In trucks and buses along the raw new roads, the poor come from the stricken north-east of Brazil. Left at the side of the road to build a new life in a frightening and alien environment, they begin their future.

The Government seeks to put a brake on the excesses of 'developers' by measures that are too often evaded or ignored. Official approval must be obtained for large-scale forest clearances, but nobody seems to bother. Regulations exist prohibiting the burning-off of forest close to river banks where animals tend to congregate. These go unheeded. . . .

Ninety per cent of the soil of the Amazon Basin is so poor that it cannot be converted into adequate pasture without the addition of costly fertilisers, and as soon as these fertilisers are no longer forthcoming, the coarse African grass it supports will go. For a multitude of small-scale ranchers three acres of land can hardly feed a single cow, and after two or three years, when the rains have washed the nutrients from the soil, over-grazing, over-trampling take effect and the dust-bowl process begins.

Wild animals are of less than secondary importance in developing countries, and little is said in newspaper polemics on the fate of the animals in the path of the fires. Their lot is death on a hardly imaginable scale. Birds, monkeys, jaguar and deer may escape the racing flames, but most of the Amazon animals, armadillos, anteaters, porcupines, sloths and frogs, are slow moving and are doomed to incineration. Innumerable bats, whose beneficial function is to keep insect populations in check, are disoriented by smoke, and fall into the flames. A great variety of small mammals, rabbits, agoutis, pacas, and rodents of all kinds are moved by instinct to take refuge in burrows or in holes quickly scuffled out in the forest litter, and in these they are roasted. Animals that live by, and in the water, otters, water-opossums and fish are doomed, too, not always directly by the fire, but the loss of forest cover, causing streams to overheat and become clogged with algae and silt; devoid therefore of both oxygen and food. An INPA scientist said: 'We are threatened with possibly the greatest ecological disaster in world history.' He had calculated that between 5,000 and 20,000 vertebrate animals were killed per square kilometre when the forest burnt down. But the burning goes on.

There is no country where the problems of conservation are so earnestly and endlessly discussed as in Brazil, no country where intentions are better and the determination stronger to protect a national heritage — in this case above all the Amazon forest, and all the life it shelters. The furious outcry provoked by the alleged proposal to hand over a huge proportion of the forest to foreign companies makes it seem unlikely that this will be allowed to happen. What is more probable is that after the clamour subsides things will be found to be drifting along much as before, with a million acres of forest quietly snipped away here and there, worse flooding year by year, yet another increase in such diseases as malaria (known to be aggravated by forest disturbance) more Indians dying of disease.

Meanwhile a new threat to the existence of the forest is about to develop — this time one that is far more likely to bring about the final solution. The appetites of the big ranching concerns have been to some extent held in check by the pressure of Brazilian opinion, but the assault on the forest to come is likely to engender less opposition, as reflecting an urgent national need.

Two barrels of petroleum substitute can be made from a ton of wood, and the Amazon forest is estimated to contain 415 billion cubic feet of timber.

From: *Observer*, London, April 1979

A new village grows up in the middle of the once unexplored jungle.

5.

The Jivaro: A People of the Rain Forest

For thousands of years people have lived in the hostile environment of the rain forest, adapting their needs for survival to the delicate and complex ecology and creating unique ways of life. This excerpt from a study of one of the Indian tribes shows what an 'adaptive' society is.

The Jivaro occupy an area of some 25,000 square miles, bounded by the mountain slope on the west, the Rio Pastaza on the east, and the Rio Maranon on the south. They share a common culture and speak the same language, but have no social or political unity. On the contrary, intense feuding and warfare between local groups continues in spite of recent efforts at pacification and missionization. The present population has been estimated at about 20,000 with females outnumbering the males by more than two to one. . . .

A Jivaro village consists of a single communal house . . . It is located in a defensible place, such as on a hilltop, at the bend of a stream, or (if the terrain is more rugged) on a rocky ledge. Although accessible to a small stream, the house is erected some distance from the bank to minimize the likelihood that passers-by will detect it. Access paths are as poorly defined as possible and provided with spring traps and deadfalls to discourage unwelcome visitors.

The house is 50 to 100 feet long (about 15 to 30 m) with straight sides and rounded ends . . . Walls are solidly constructed of closely spaced vertical poles, and the roof is thatched . . . Lances, blowguns, looms, and other kinds of male property are arranged along the walls, while smaller objects are stored in baskets or nets that hang from hooks suspended from the rafters or are laid on the shelf over the bed. A large signal drum is hung horizontally near the door.

. . . . Cooking fires are located near the entrance. . . . Pottery vessels of various sizes, gourd water bottles and bowls, and other domestic utensils stand on the floor or are stored on hanging racks. Tied to the foot of each bed are two or more dogs.

The Jivaro staple (food) is sweet manioc, and a large garden is cleared at the time a new house is constructed. One or more additional fields are made in the nearby forest when

production of the first field declines or when additional food is required for a special feast. The men cut the vegetation and burn it, while planting, weeding, harvesting, and garden magic are primarily tasks of the women. Men plant maize, cotton, and barbasco (fish poison), however. . . . Staples in addition to sweet manioc include chonta or peach palm fruit, sweet potatoes, squash, papaya, and peanuts . . . Bananas, plantains, and sugar cane have been added recently. . . .

At the conclusion of the manioc planting, a festival is held on five successive nights, during which the women of the household dance and chant to promote the growth of the plants and to protect them from damage. Incantations, magic, and dietary restrictions are employed on various occasions for the same purposes, particularly by the women, who are believed to have a special relationship with the plants.

Most of the women go daily to the garden to tend the plants and to harvest food. Another constant and time-consuming female activity is the processing of sweet manioc into a fermented drink, several quarts of which are consumed daily by each adult. . . .

One or more of the men hunt daily, and their intimate knowledge of the environment and habits of the fauna, combined with a varied repertoire of methods (including imitation of calls, construction of lures and traps, and skill with the blowgun and lance) usually produces results within a couple of hours. When the trail of a band of peccaries is discovered, a communal hunt is organized and the meat divided among the group. Dogs are specially bred and trained for hunting, and one of the major Jivaro feasts is that given when a dog is full-grown.

Deer and tapir are not eaten because of their supernatural qualities, but all other kinds of game animals and birds are consumed, including monkeys, sloths, anteaters, caymans, and birds — even very small ones. Snakes, beasts and birds of prey, vultures, and most nocturnal birds are not eaten.

Like other northwest Amazonian tribes, the Jivaro eat a number of insects. Especially favored are a red ant and the large white grub of the chonta beetle, whose flavor has been compared to pork sausage spiced with nutmeg. Turtle eggs are another delicacy, exploited seasonally. Numerous forest plants supply the fibers, woods, resins, and other raw materials for the manufacture of most articles of material culture, in addition to medicines and magical substances.

Men perform all tasks involving wood, such as house, bed, and loom construction; canoe making; and carving paddles, drums, lances, blowguns, darts, digging sticks, and shields. They also weave baskets, spin and weave cotton, and make many of the ornaments they wear. Women have special affinities with the earth and are constantly assigned earth-related activities, including agriculture, pottery-making, and cotton-dyeing. . . .

The only specialist is the shaman. His principal function is curing, but through his control over the spirit world he can also influence weather, cause death or illness, and identify the culprit in case of death . . . since the Jivaro look upon the death of any adult as an unnatural event for which sorcery is responsible, and since all shamans are sorcerers, he becomes a primary target for blood revenge. . . .

Although each Jivaro household is an economically and politically independent village, it is part of a larger social

group composed of about half a dozen houses occupied by related families scattered over a distance of some nine miles along both sides of a small stream. . . .

Their constant state of mutual enmity does not prevent trading between Jivaro subtribes. Certain kinds of objects, such as salt and the palm used for arrow shafts, are not available everywhere in the region. Other traded items are blowguns, arrow poison, small drums, and hunting dogs. In recent times, the Jivaro have obtained pigs, chickens, axes, knives, guns, ammunition, and cloth from their civilized neighbors in return for salt, deer meat, and blowguns. Trading is done on an individual basis; and a person travelling through enemy territory on a trading mission runs the risk of becoming a target for blood revenge. . . .

Heads of adults who are not related to a member of the war party are taken as trophies, after which the victors retreat as quickly as possible. When they feel safe from pursuit, they erect a temporary shelter and undertake the shrinking of the heads, a process that requires about 20 hours. The party then continues home, where the victory celebration begins.

The Jivaro envision the world as containing spirits that inhabit people, animals, plants, striking geographical features (such as hills, rapids, and volcanoes), and even objects of human manufacture. These spirits may move from one "home" to another, and the spirits of human beings often enter certain animals, especially the deer and the tapir.

From: *Amazonia,* by Betty Meggers, 1971

AMAZONIAN INDIAN TRIBE FACES DESTRUCTION

The largest remaining isolated tribe of Amazonian Indians in Brazil is facing destruction.

Anthropologists from universities in Brazilia, Sao Paulo and Rio de Janeiro and Catholic and Protestant missionaries working with Indians are protesting against plans by a Government agency to create 21 reserves for the Yanomami tribe who inhabit vast areas of forest near the Venezuelan border.

The reserves, proposed by the much-criticized National Foundation for the Indian (FUNAI) but still to be formally decreed, would be scattered pockets of land in the 15 million acres of the tribe's traditional area.

These pockets, say the critics, inevitably will become surrounded by colonists bent on exploiting the land and its resources. The forest will be felled for agriculture and ranching and a "mining invasion" will take place. Large mineral deposits, particularly uranium, have already been discovered in the region where one of the largest concentrations of the Yanomami live.

Protestors say that the reserves would be small "Bantustans", too restricted to sustain the Indians. They are shifting cultivators who move their villages every few years, and thus need large areas of land to survive. Their system of exploiting the land is much more suitable to the fragile soils of the area than the modern methods of colonizers, which usually swiftly exhaust the soil.

Sunday Post, Ottawa, March 11/79

6.

Amazonia: The New White Promised Land?

A pact which aims to reconcile development and conservation throughout the Amazon basin has recently been signed by eight Latin American countries. The treaty recognizes that the vastness of Amazonia — an area larger than Europe — can no longer protect it against unplanned development.

The pact is in favour of "rational utilisation of natural resources". But how "rational" is a plan to settle 150,000 embattled whites from southern Africa on land which is mostly virgin jungle? The eight signatories (Brazil, Bolivia, Colombia, Ecuador, Guyana, Peru, Surinam and Venezuela) are now committed to "expanding the joint efforts being made for ecological conservation". But this has not prevented the Anglo Bolivian Land & Cattle Company from selling off huge areas of the forest, at knockdown prices, to buyers in the rich nations.

The 1978 treaty is overdue. It makes sense for the countries sharing the planet's largest freshwater system to cooperate in its development. The pact will facilitate a greater exchange of raw materials and goods between the Amazonian countries.

There is an important practical impetus behind the pact's emphasis on conservation. Biologically, the Amazon is the richest region on the planet, and may contain a million different plant and animal species. This great diversity represents the Amazon's greatest resource — it is one of those 'gene pools' on which depends the health of all species planted or farmed by man.

The Anglo Bolivian Land & Cattle Company is offering 70 hectare (160 acre) slices of the forest around Santa Cruz in eastern Bolivia for less than US $3,000. The prospective buyer receives a glossy brochure with photographs of land cleared so recently that it is still littered with burnt trees. There is no mention of the Chiquitano Indian whose homeland is being sold at $40 per hectare ($18 an acre).

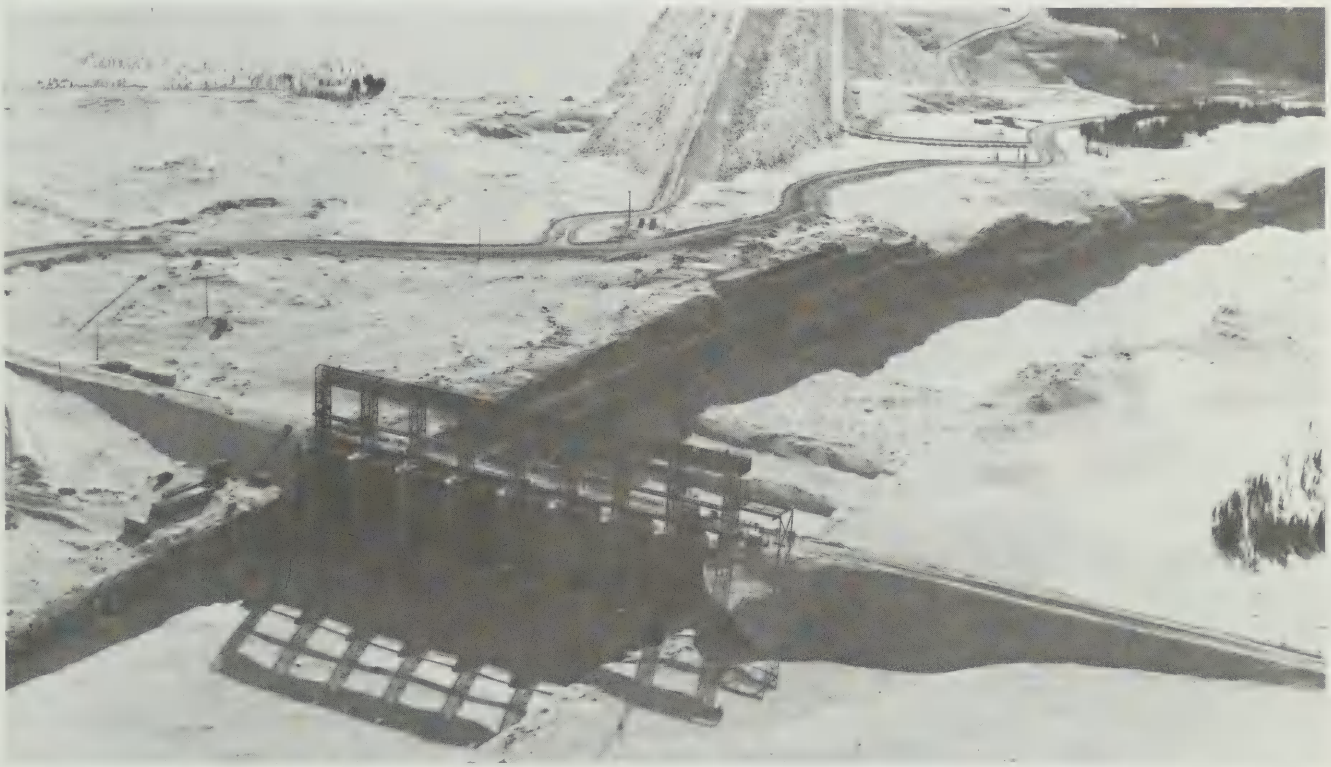
Settlers taking up the Anglo-Bolivian offer will be a trickle in comparison with a fantastic project to turn Bolivia into sanctuary for 150,000 beleaguered whites from southern Africa. Presencia — the leading Bolivian newspaper — has alleged that the West German government, backed by the United States, UK and France, will foot the bill for this great white exodus. The Bolivian Under Secretary for Immigration was reported as saying that his government would encourage the "entry of large and important numbers of white immigrants . . . especially from Namibia, Rhodesia and South Africa".

The Bolivian authorities want the technical and agricultural skills of the South African whites to open up the sparsely populated eastern region, which occupies an area larger than Spain. Plans are well enough advanced for special Bolivian consular offices to have been set up in Rhodesia and South Africa.

The social and political consequences for Bolivia, a country with the lowest per capita income in Latin America, and where 85 per cent of the population is Indian, are obvious. The future for the 41 Indian tribes in this remote region is grim.

Close to a million hectares (almost 4000 sq miles) of virgin jungle and savannah, much of it unsuitable for agriculture, have been set aside for the white settlers. The government expects the legendary ruggedness and industry of Africa's Europeans to work miracles. If this happens, another part of the unique Amazonian rainforest will have disappeared for ever.

From: An article in *Earthscan* by Robert Lamb, 1979.



II.

THE SEARCH FOR HYDRO-ELECTRIC POWER

Energy is fundamental to industrial growth. Developed and developing nations alike search for new ways to power the wheels of progress, power for new industries, for new standards of comfort. One of the oldest and favorite sources of energy is hydro-electric power, the damming of rivers to create man-made lakes and control the flow of water.

Hydro power is cheap, makes efficient use of one of nature's great natural resources, for mans benefit. Few of the great rivers of the world remain to be tampered with.

7.

Superdams — The Perils of Progress

Superdams have been looked on as engineering miracles — which they are — and the cheapest source of power for electricity — which they may not be, given the many side effects which are now being assessed as the true cost of such projects around the world. This excerpt surveys the issues which have arisen around the world from the construction of massive hydro-electric projects.

What happens when we dam the flow of a great river and form an immense body of water where there was none before? We are not sure. Yet we have been persuading the world's poorer countries that there is nothing like a really big dam for a fast economic takeoff. Dozens have been built on this assumption over the past ten years: in Pakistan, India, Thailand, Laos, Iran, Ghana, Nigeria, Zambia, Egypt, Brazil, Peru, Honduras, to list a few. But the takeoff hardly ever comes, since no sooner do the dams go up than something unforeseen arises. Calls for help unfailingly follow, international agencies respond, experts fly out, information rolls in. . . .

The changes needn't necessarily be for the worse. Fish have been known to multiply exuberantly in newly made lakes, in the tropics especially though not right away or forever. At first, rotting vegetation makes the water black and so short of oxygen that not many fish can stand it. Most river fish can't, anyway. But then the water clears and other species come along, living like lords as they sport among the sunken village huts and fatten on the decaying plants, decomposing animals, and each other. In Thailand, thirty-three species disappeared from the lake behind Ubolratana Dam within a year of its formation, while the cannibal murrel population doubled. In Ghana, six sorts of mormyrids and the abundant Alestes Nurse were extinct in Lake Volta within a year, whereas several sorts of cichlids and lates — exactly a year old — showed up in fishermen's nets for the first time. (They used to live in the river's still pools and backwaters, shunning its swifter downstream currents.) . . .

The catch in Lake Volta itself dropped by a fifth in 1971, and the lake behind Zambia's giant Kariba Dam seems to be getting very nearly fishless. Formed five years before Lakes Volta and Nasser, Kariba showed dazzling promise. Experts predicted an annual fish catch of twenty thousand tons in no time. Yet it was down to four thousand tons by 1963, half that by 1964, and so little by 1967 that a corps of two thousand fishermen shrank to five hundred.

FAO fishing experts, summoned by the score to the rescue, can still only guess at some reasons: over-fishing, undercropping, poor gear, too many drowned trees getting in fishermen's way, too many predatory fish overindulging. The one cause they can be certain of, though, is the waterweed.

The Deadly Hyacinth . . .

Waterweeds can be prettier than they sound, particularly the lush pink water hyacinth, which happens to be the most depraved. Once it was, in fact, just a charming Japanese flower. Then it went off with somebody or something to South America, where it began to show up whenever the weather was warm enough. Breeding sexually and vegetatively and growing a mile a minute, it can form mats thick enough for a man to walk on. By now it is choking rivers, lakes, bayous, canals, even ponds in several U.S. Gulf States, most of Central and South America, nearly all of Africa from Zaire and Rhodesia to Tanzania and Madagascar, and eastward to India, Pakistan, Indonesia, Thailand, Vietnam, New Zealand, Australia. The whole length of the Congo River has been clotted with it; fourteen billion cubic meters of water, half the White Nile's flow, are lost every year in the Sudan's great Sudd Swamps because of its transpiration; all three of Thailand's newest man-made lakes are failing to fill for the same reason; irrigation ditches are blocked and river boats stalled by it; fish trapped under its heavy blanket die for want of food and oxygen as it cuts off more and more sunlight and air; and because it can so easily become entangled in a dam's penstocks or trashracks and so clog the turbines — its cousin the water lettuce very nearly put the Kariba Dam out of business that way — almost every hydroelectric project built in the tropics since World War II is menaced by it.

So far, waterweeds like hyacinth have survived every assault we can dream up, saw boats with Rube Goldberg contraptions, leaf-eating beetles and weed-eating fish, herbicides poured, painted, and sprayed from boats, the shore, the sky. They are either too expensive or too poisonous or no use. An ideal solution would be the manatee, mermaid to sailors of old, who has a wonderfully sunny nature and does nothing but eat water hyacinth all day long. Unhappily, manatees make such good eating themselves that they rarely have time to mate before humans take them home for dinner.

Development planners are learning not to count too much on all those fish in man-made lakes — or, to their more considerable shock, on all that water. Water, in boundless supply, was supposed to be one of the two big prizes. What wonders could not be worked with it, they would ask, for farmers struggling with parched soil or for countries with too many people and too little arable land?

Quite a few of these lakes were never meant to store water for irrigation in the first place. They were to provide enough for the turbines, and they can come dangerously close to falling short even of that because they evaporate, or transpire, or silt up, or leak. Evaporation takes fifteen billion cubic meters of water a year from Lake Nasser; that is nearly double the engineers' original estimate (they forgot to calculate the higher wind velocity on a big body of water) and more than a quarter of the Egyptians' whole allotment from the Nile, practically their sole source. Transpiring water hyacinth can take ten times as much, meter for meter. Silting has cut the storage capacity of Lake Austin in Texas by 95.6 percent in thirteen years, and of Algeria's Habra Reservoir by 58 percent in twenty-two years, while West Pakistan's $600 million Mangla Dam is expected to silt up completely in fifty years. And any reservoir with big cracks or open passages in the earth around or under it can leak. The United States has had to abandon several because of leakage or seepage: Cedar Reservoir near Washington, the McMillan and Hondon in New Mexico, the Tumalo in Oregon, and Jerome in Idaho. But the most spectacular case is Lake Nasser. . . .

The people

Nobody knows the value in money of all the land, plants, timber, ancient monuments and artifacts, villages, and towns lying at the bottom of the world's man-made lakes. The millennial site of Abu Simbel's twin temples and the

whole Sudanese town of Wadi Halfa are among them. So are some of Ghana's richest cocoa farms and Zambia's two-crops-a-year alluvial lands on the banks of the Zambezi. Giant stands of teak are now dying in the Ivory Coast's Bandama Valley; and when and if the first mainstream dam is built across Southeast Asia's Mekong River, at Pa Mong, nearly a million acres of prime paddy land will go under in Northeast Thailand and the magnificent Laotian valleys of Ban Done and Vong Vien.

Nobody is quite certain, either, how many people have been forced to move by the rising waters. There are always some who take to the hills never to be heard from, as happened in the Tennessee Valley. To the best of our knowledge, a hundred thousand were displaced in Egypt and the Sudan, nearly a hundred thousand in Ghana, at least a hundred thousand in the Ivory Coast, and half a million may join the list should the projected Pa Mong Dam eventually span the Mekong. . . .

The problems of disease

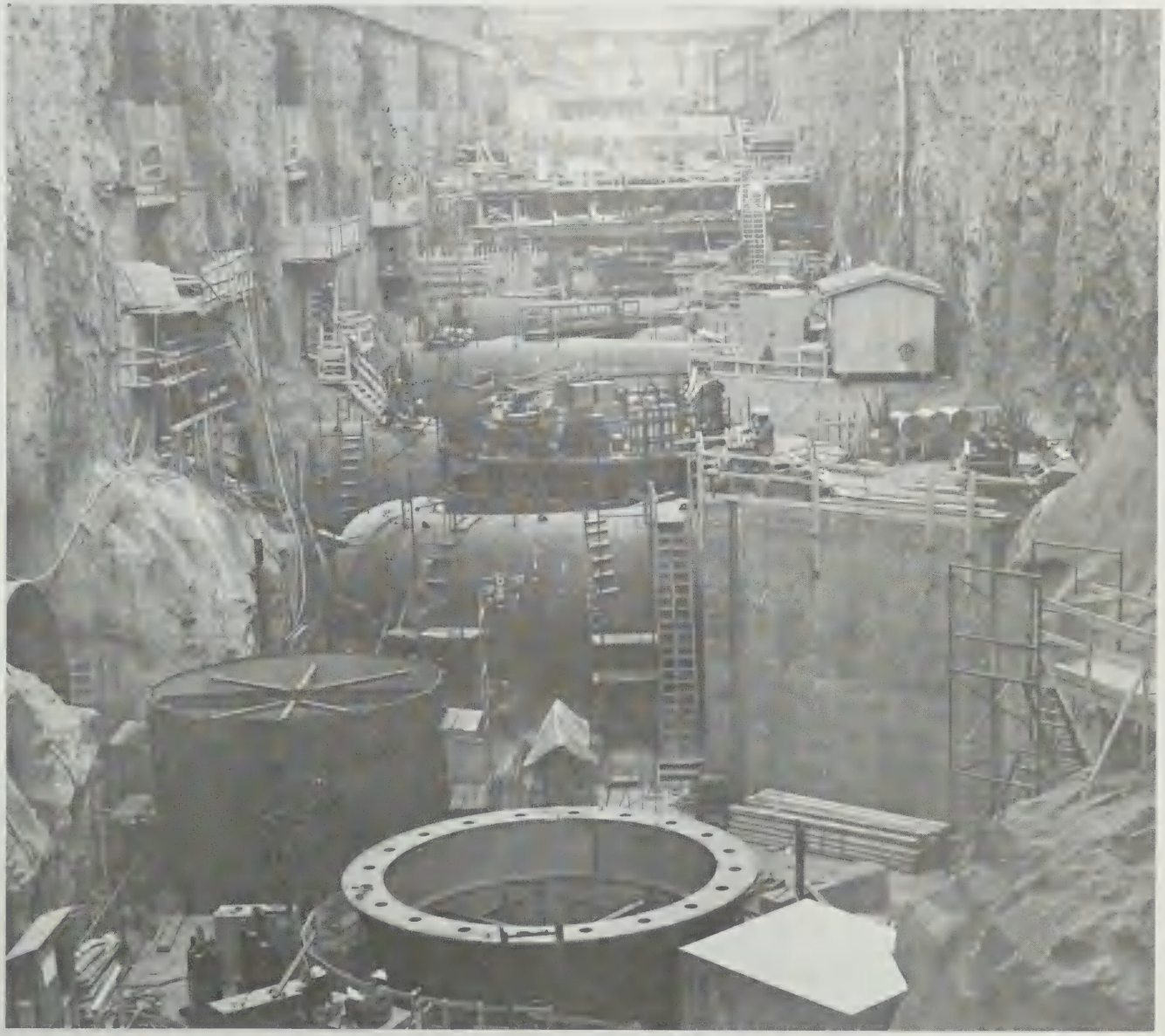
Wherever a superdam has gone up in tropical Africa and Asia, the lake behind it has brought an explosion of water-borne disease. Even small dams can do it, as the Ivory Coast has learned. One built there at Bia in 1964 managed, within a year, to bring on raging epidemics of river blindness (eight hundred cases), sleeping sickness (two hundred cases), and bilharzia infecting four out of every five inhabitants. Fortunately there weren't many inhabitants. When Lake Kossou fills, though, World Health officials expect "a very serious threat" of sleeping sickness among a hundred thousand refugees and others on its densely populated shores, "endemic" bilharzia and malaria, a "special danger" of yellow fever, a "violent outbreak" of guinea worm — the fiery serpent of the Bible — and a chain of "excreta illnesses" such as dysentery, cholera, and typhoid. . . .

There are several other ways in which a superdam can cost more than its list price: the scouring of riverbeds downstream undermining other dams and bridges; the erosion of coastal dunes and sandbars, thereby endangering cities like Alexandria and permitting seepage of salt water into sweet-water lakes; the loss of ocean fish should the dam withhold organic silt required for the aquatic food chain (Egypt has lost 18 000 tons of sardines a year that way, and if just two projected mainstream dams are built on the Mekong, the owners of 300 000 fishing boats at the river's mouth might go bankrupt); landslides, and earthquakes on the magnitude of six or more on the Richter scale, such as the one touched off by India's Kogna Dam in 1967, which killed 200 people.

The payoff is supposed to come from hydroelectric power. There, in the installed capacity of kilowatt-hours, lies the secret of the economic takeoff, or as planners say; and judging from the comparative figures — 6615 kWh per person in the United States, 6746 in Sweden, 2364 in Soviet Russia, 79 in India — they ought to be right. But power installed is not necessarily power consumed, as the Egyptians, who have yet to find a use for even a third of theirs from Aswan, have discovered.

The capacity can be enormous. The High Dam's is ten billion kilowatts a year; the Tarbella's in Pakistan is almost as much; the Pa Mong's on the Mekong would be twice that; and if all forty-odd dams under consideration in the Mekong Development Scheme were built, they would plunge all Indochina — indeed all Southeast Asia — into a blaze of light. Then what?

The power produced would be cheaper than thermal or nuclear power, but only if every kilowatt-hour were consumed from the start, over a span of a hundred years. Even this would not take into account the social and ecological costs of uprooting several million people in the Mekong Basin, drowning several thousand villages and hamlets in fertile river valleys covering the better part of 25 000 square kilometers, spreading sickness among men



and cattle, dispersing or killing off a great many fish in the river and sea — the giant prawn and unique ten-foot-long catfish would be among the first to go — scouring 1 500 miles of riverbed, and putting an end to the annual silt laden floods nourishing twelve million acres of luxuriant delta soil in Cambodia and South Vietnam.

To use the power, furthermore, everything taken for granted in an advanced industrial state would have to be developed: grids, factories, transport, communication, trained workers, seasoned management, markets — in short, the *acceuil* (the French seem to have the only word for this) without which the power goes to waste. On those terms, the Mekong's dam network would cost from $25 billion to $50 billion. No poor Asian or African country, with so few skills, so little experience, such meager capital, could be sure of success even then.

It is curious but true that such calculations simply weren't made until quite recently. Engineers honestly didn't know they were committing ecological sins: who did? Rich countries putting up the money sincerely thought of themselves as benefactors. Poor countries were suitably grateful, and displaced people getting pushed around never seemed to fall into anybody's department. . . .

From: *Superdams*, by Claire Sterling, 1972.

8.

The Aswan Dam: Boon or Bust?

One of the most vivid examples of what can happen when a superdam is built is the great Aswan Dam of Egypt. Meant to solve so many of that country's pressing problems of food and poverty, the dam seems to add a new dimension to the people's struggles against the difficulties of their natural environment. This excerpt details some of the concerns illustrated in the previous article.

In 1960, President Gamal Abdel Nasser pulled a lever and ignited 10 tons of dynamite to blast Egypt into a new age of prosperity. The explosion was the start of the Aswan High Dam. Seventeen thousand Egyptians and 570 Russians labored on the huge project — 17 times bigger than the Great Pyramid — that was to water Egypt's fields, power its new factories and light its villages.

Instead of prosperity, the $1-billion barrage across the Nile has produced what may be calamity. One member of Parliament has called the dam a disaster and suggestions have been made to bore a giant hole in it.

The fertility of Egypt's soil has declined as the dam cut off the annual flood of 30 billion tons of silt, which used to make the Nile Valley the world's richest farmland. Egyptian farmers now have to buy fertilizer to replace the fertile mud.

The banks of the Nile are eroding. Parts of Egypt's Mediterranean coast are being eaten away. With their food chain broken, fish have fled from the river's mouth and the Egyptian sardine industry — 18 000 tons a year — has been wiped out.

Disease is spreading as the water-borne bilharzia parasite infects more Egyptians; half the Egyptian population is estimated to suffer from the intestinal and urinary ailment. U.S. space satellite photos show that without the annual river flood to coat the land with mud, massive dunes from the desert's Sea of Sands are drifting over the fringes of the farmland.

And most crucial of the dam's side effects: because drainage was not installed in the irrigated land, salt is rising to the surface in deadly white crusts that threaten to turn existing farms to wasteland. In a vital rescue operation, the World Bank is draining more than a million acres to get rid of the salt, and the Egyptian Ministry of irrigation "is filled with drainage projects," said an official.

Eighteen years after the Aswan High Dam was begun, 430 miles south of Cairo, Egyptian and Western authorities are still poring over studies and arguing about its effects. Supporters of the project maintain that despite its drawbacks and disruptions, Egypt had no choice but to build the dam. (And the Soviet Union, which financed it, cannot be blamed for its flaws; the project was designed by West German engineers and was endorsed by the United States before Moscow took it on.)

The programme . . . would virtually double Egypt's arable land.

An Egyptian Government report conceded that Aswan had drastic faults but said it had reclaimed 812 000 acres of land for farming. It increased crops in another 793 000 acres. It controls flooding and it preserves water for use in dry years. Without the dam in 1972, said an official, drought would have cost Egypt a third of its crops. And although six of Aswan's 12 big Soviet turbines, buried in tunnels under 436 feet of granite and concrete, stand idle, the generators produce almost six billion kilowatts of power a year.

With the Aswan dispute still going on, Egypt is now embarking on another project as ambitious as the High Dam to feed and house its hungry and overcrowded people.

President Anwar Sadat plans to make 2.8 million acres of desert bloom in the barren sand of the New Valley, northwest of Aswan. He also plans to build huge new communities in the Sinai Peninsula after Israel withdraws from Sinai under the Camp David peace accords. The program, if it ever succeeds, would virtually double Egypt's arable land.

The price tag, too, would be colossal. Experts say reclaiming the desert costs $3,000 or more per acre; every inhabitant installed in a new community means a cost of $71,500. Yet Egypt, which has not made clear where the money would come from, is thinking in terms of eventually moving perhaps two million Egyptians, or perhaps 14 million, or 23 million, or more, into the desert.

Without the yellow wilderness Egypt has nowhere to turn. Its 40 million people are jammed tight into 4 per cent of the country — 96 per cent of Egypt is empty desert. The population has more than doubled since the Second World War; it is expected almost to double again by the year 2000. Cairo alone is so crowded and decaying that buildings occasionally fall down and kill their occupants.

"Land reclamation and desert development are inevitable," Mr. Sadat told planners, and he gave them a slogan: "The green revolution and the conquering of the desert."

To move significant numbers into the desert Egypt needs more than farming communities. It needs dozens of towns and cities, and nuclear power and solar energy to run them (U.S. desert scholar Lloyd Smith of Nevada calculates that the sunshine on Egypt's Western Desert, even inefficiently harnessed, is enough to meet the total energy needs of the United States). Tentative plans call for population centres built around natural resources, industrial projects, education and research enterprises, health and tourist attractions and military settlements.

New technologies would be needed to meet the problems, and the techniques must be simple. "You cannot expect peasants who can't read or write to adapt to sophisticated methods," says Prof. Bishay. For many an Egyptian farmer, who lifts his water from the Nile with a wooden machine designed thousands of years ago, a tractor would be a bewildering advance, and learning how to make bricks from sand instead of from Nile mud is a problem even for an engineer.

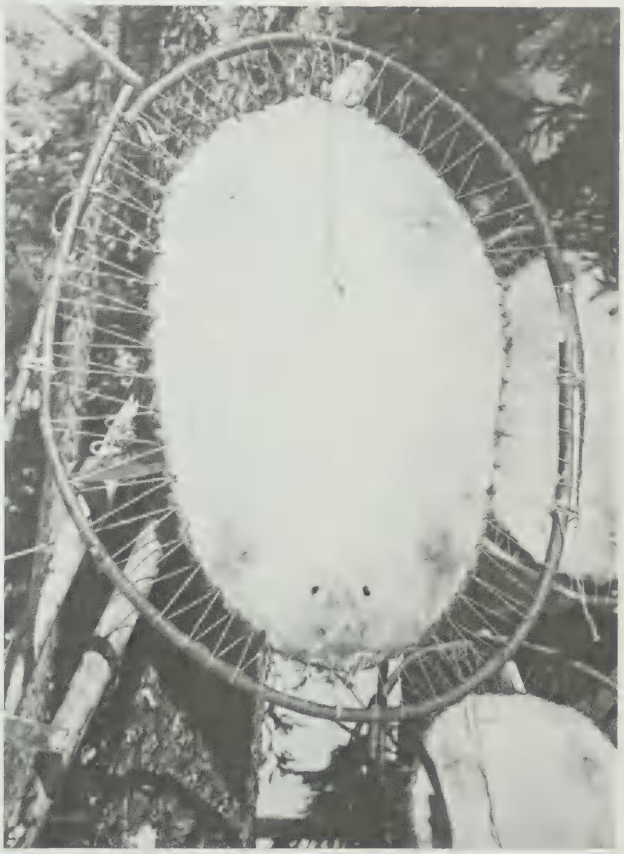
Water must be found, either from Lake Nasser, the 300-mile-long lake created by the Aswan Dam, or from underground sources, and these must be studied and tapped with exceeding caution, notes Prof. Bishay. (Thirty-four ministries, departments and organizations are still trying to figure out Lake Nasser's potential. In more than a decade it has not yet filled to its proper level and one expert, Prof. Abdel Goher, fears it may take two centuries to do so.) For the settlements in the Sinai, Egypt already is digging a tunnel under the Suez Canal to carry water from the Nile.

From: An article in the *Globe and Mail*, 1975

9.

The James Bay Power Project

The Aswan Dam is past history but at the time this article was written the James Bay hydro-electric project was still only a proposal. Today the project is in operation and the concerns reflected in this article can be tested against the reality. The considerations and the concerns that created the political, social and environmental story of James Bay are being played out in other parts of Canada. Will the story of Aswan and James Bay effect the future choices of Canadians?



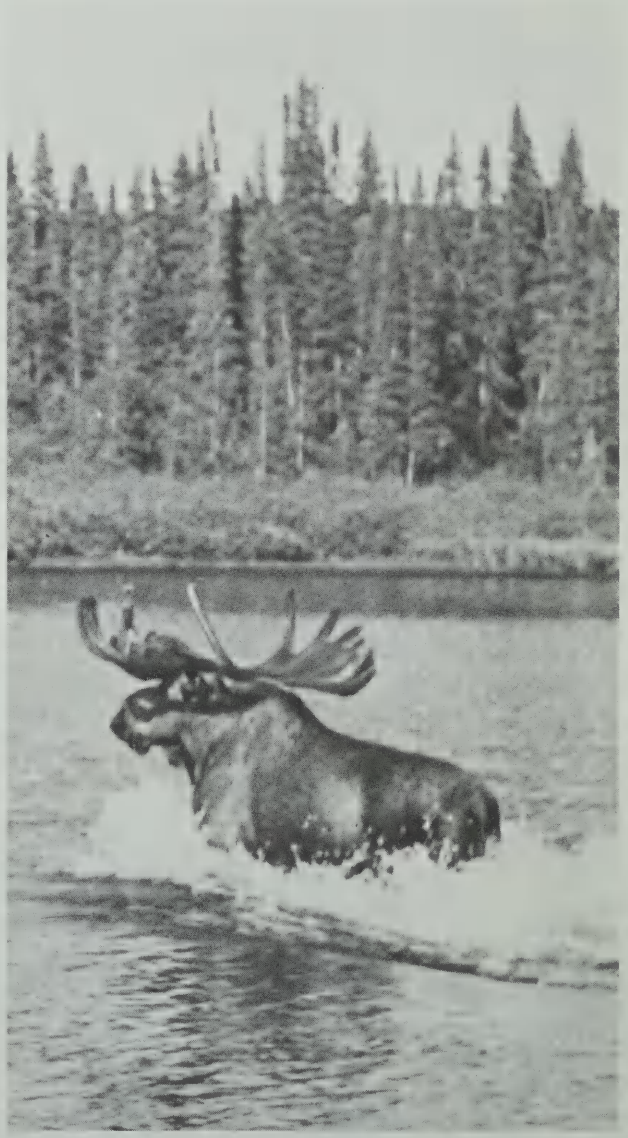
Flying low over the vast Quebec wilderness east of James Bay, the observer can glimpse complex terrain below — muskeg and forest, alternating with hundreds of small lakes set in the ancient Precambrian rock of the Canadian Shield. This is the subarctic, and Hudson Bay itself is the predominating influence. Cold waters of the Bay force plant zones and treeline farther south here than in any continental region of the world. Ice covered in spring, and very cold in summer, the large water mass lowers the air temperature and causes the formation of fog, retarding plant growth. Melting of the ice begins in May, but throughout the summer, cold Arctic air sweeps down unmodified along Hudson Bay into northern sections of Ontario and Quebec. In effect, Quebec and Ontario have an Arctic Ocean along their northern boundary.

White spruce marks the windswept James Bay coastline,

which serves as the staging area for practically all of the Blue Geese in Canada. Leaving northern nesting sites in early September, these birds descend on the rich tidal flats of east James Bay in great numbers. Along with a few flocks of Lesser Snow Geese and the common Canada Goose, the birds rest and forage at the intertidal zone for several weeks before making the long flight south to wintering grounds along the Gulf of Mexico. Akimiski Island, a bird sanctuary, and Twin Islands, denning spots for the polar bear, lie offshore. Each fall, eel grass beds south of Charlton Island feed approximately 100 000 Eastern Brant, 90 per cent of the world population of this species.

Inland from the coast, black spruce and balsam fir form the closed forest association, along with broad-leaved trees like white birch, aspen, and balsam poplar. Alder often creates thickets along the watercourses. Furbearers include the river otter, muskrat, wolf, and lynx, and the beaver is especially important to the native people for food and fur. Woodland caribou and moose are the large game animals of the area. Caribou is found in mature coniferous forest, while the moose depends on submerged aquatic vegetation during the summer, turning to twigs and shrubs throughout the winter months. Beaver, moose, and caribou are vital sources of food for 6 000 Cree who trap and hunt in the James Bay region. Seasonal geese, and fish resources such as lake trout and whitefish also supplement the protein requirements of the native people.

Proceeding north and east, the traveller sees the closed forest canopy give way to the taiga or open boreal forest, described as one of the most picturesque, colorful, and extensive landscapes of the continent. Tall spruce stand several yards apart in a sea of *Cladonia,* the caribou lichen or reindeer moss. These lichens cover the forest floor in pastel shades, and retain the impress of footprints for many years. In northern James Bay, the country is particularly beautiful



in early summer when flowering herbs and heaths contrast against lichen-covered granite and reindeer moss.

The Cree who make this land their home are a self-sufficient people, living in five main bands ranging from the treeline south to Lake Waswanipi and east to the caribou country around Lake Mistassini. . . .

The project calls for the creation of five to ten of the world's largest dams, two new airports, one new ocean port, and a total of 500 miles of new roads into the wilderness. Five to seven river basins may eventually be involved, and the first phase could call for the development of the Nottaway, Broadback, and Rupert Rivers as part of a complex. The first two rivers will be diverted into the third through an elaborate tunnel system, and the entire "NBR" system will flood 1 700 square miles, an increase of 50 per cent in the present water surface area in the virgin territory. Total power output of the NBR system is estimated at 5 545 MW (megawatts) at a cost of $4.1 billion. Development of the Eastmain and the La Grande, more northern rivers, is expected to produce a total of around 12 000 MW at a cost of $7 to $10 billion.

Biological Effects of Flooding

Engineering maps show that the first area to be flooded will affect a drainage basin of over 50 000 square miles. In the "NBR" area, Hydro-Quebec estimates that 1 700 square miles of woodland will be submerged; Lake Mistassini, doubled in size from its present 900 square miles, will fluctuate as much as 20 feet when drawdown occurs. Up to 70 feet in fluctuation is predicted for the Waswanipi reservoir on the Nottaway River, and one reservoir on the La Grande River in the northern basin is scheduled for a 223 foot drawdown! Actual flooding will, of course, displace or eliminate animal life in the areas indicated, and due to fluctuation, the edges of the new reservoir will soon become barren mud flats, unable to support life. The shoreline will be a tangle of dying trees if the forest is left uncleared, and even if the water levels were maintained, decades would pass before animal habitat could re-establish here.

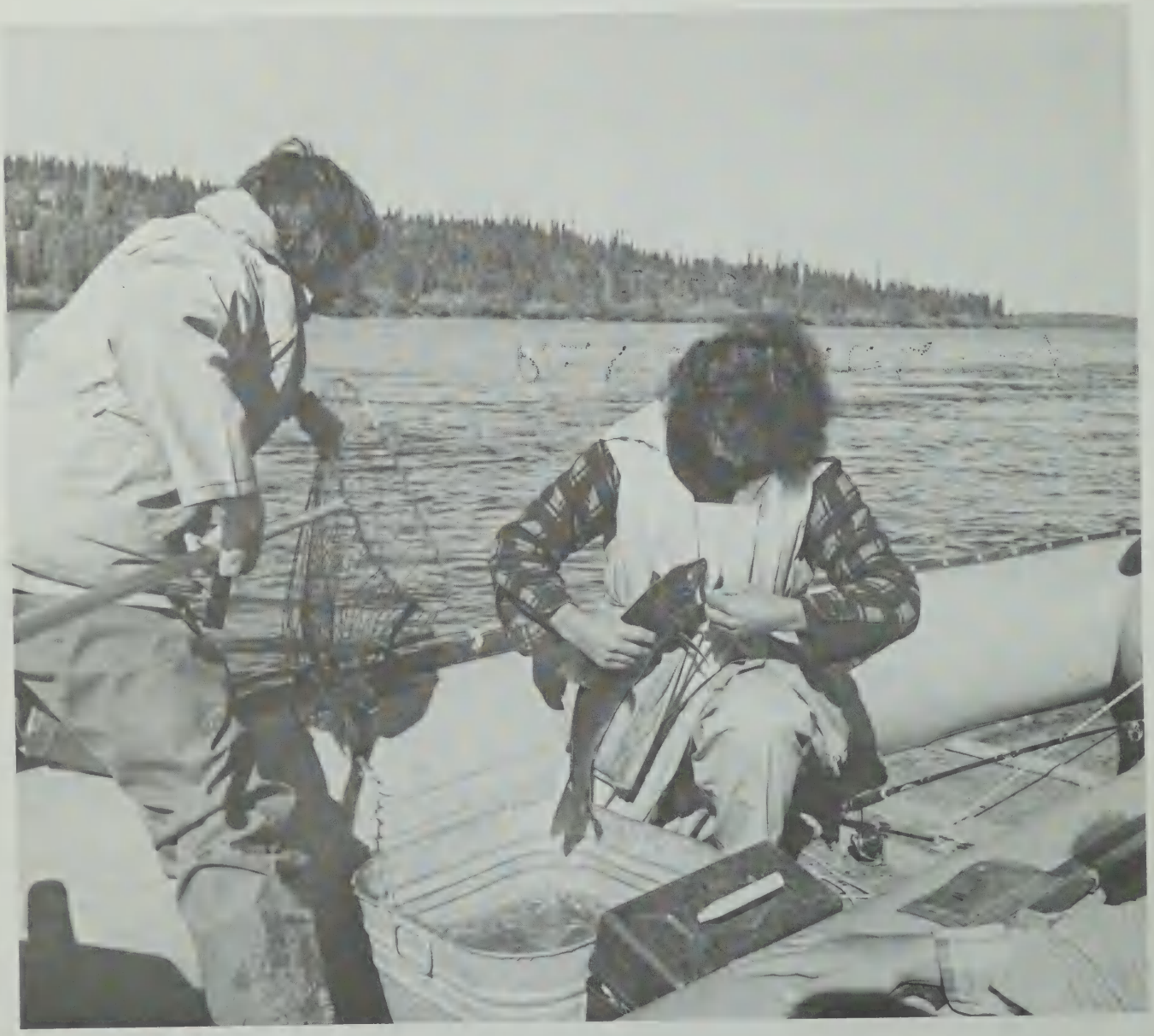
All food fish in the James Bay region are littoral spawners, meaning that they must lay eggs in shallow, inshore areas on gravel bars or on vegetation. Eggs of fall spawning whitefish, lake char, and brooktrout will be exposed to freezing or dying by changing levels in the shallow water. Essential sources of food for larger fish, the shiners and minnows, often spawn in spring and early summer in the same inshore area. Thus, the most desirable fish will diminish and disappear from those areas flooded by fluctuating reservoirs, and slow growth rate in these waters means that replacement with less desirable species may take several decades.

Research has shown that reservoirs follow a cycle after filling, first increasing in productivity due to organic material in the water, then declining in plant and fish production. This is followed by stabilization, requiring 25-30 years in this latitude. Therefore, even those reservoirs with no drawdown will show a drop in production for many years.

Biological effects of changes in salinity and silt deposit on the intertidal zones and offshore islands of James Bay are unknown at present.

The Foreshore Effect

Maps showing the central areas of flooding mask the actual results. Because of low topography, an additional, unknown number of square miles will be seriously affected away from the reservoirs. Many hundreds of surrounding



small lakes and marshes (the foreshore) will be influenced as the main reservoirs rise and fall, contributing to decline in fish and aquatic life. In turn, this will affect mink, river otter, muskrat, beaver, and moose. Lodges and burrows of muskrat and beaver may be exposed, and the young subject to predation. Submerged plants on which the moose depend in summer will be eliminated in many areas. The effect on the native people dependent on these resources over hundreds of square miles is likely to be severe.

Climate

Climatic changes may be one after-effect of James Bay development not confined to the local area. Ice break-up and warming of Hudson Bay depends on fresh water from the rivers, but dams and river diversions will combine to reduce spring flow and mixing. Dr. Lloyd M. Dickie of the Bedford Institute in Dartmouth, Nova Scotia, has warned that longer winters for Ontario, Quebec, and the Maritimes, with possibly greater snowfalls, could result if the project continues unaltered. Vegetation limits are already in a delicate state of balance in the Hudson Bay area. Studies have shown that, due to slight differences in annual temperature, the treeline has shifted almost 180 miles (290 km) in the last 900 years.

The Cree

The James Bay region is one of the few places in North America where Indians still have an intact culture based on a traditional way of life. Social scientists have noted that the integrity of the various bands has not been undermined by welfare, and that approximately 75 per cent of the adult males are dependent on hunting and trapping for a part, or most of the family food or income. Desertion of the traditional way of life has not occurred here, as some have predicted. On the contrary, although the Waswanipi bands live close to the various posts (Matagami, Miquelon, Chapais, and Desmaraisville) all year, over one-half choose to go back into the bush during the winter to maintain themselves by hunting and trapping.

The Indians are dependent on ecological balance for their preferred way of life. For the Waswanipi, beaver accounts for 20-45 per cent of total calories, moose approximatly 15-40 per cent, and fish 1-13 per cent. In the fall, seasonal geese provide an essential 7,500 pounds of meat for coastal residents before the start of the trapping season.

Strongly opposing the James Bay project, northern Quebec Indians called on Prime Minister Trudeau to ask his personal intervention in seeing that Indian rights in the area were protected. A letter from the Indians of Quebec Association maintained that the territory, traditional hunting and trapping land, belonged to them.

In addition to biological effects of flooding it is feared that new roads, beginning with a paved highway to Rupert House, will bring in an influx of sports hunters, with possible depletion and overkill of the animal resources. It has been predicted that the number of hunters at the geese staging area will triple immediately, and continue to rise sharply. Canadian Wildlife Service personnel fear that the effect on geese is likely to be severe. In the past ten years, the impact of sports hunting has increased, and one-third of the annual moose kill currently goes to the sports hunting sector. In the late 1960's, officers of the Quebec Department of Fish, Game, and Tourism warned Waswanipi Indians not to hunt outside the several week fall season under threat of prosecution, and regularly searched the winter camps for signs of moose meat, which provides up to 40 per cent of the total calories available during the winter. Clearly, development of any of the area resources, particularly massive hydro projects, must be co-ordinated with Indian needs. In the past, this has not been the case, with resulting ecological disruption and social hardship. Premier Bourassa has said

only that he did "not think that the Indians will be an obstacle to the development of James Bay."

Uncomfortable similarities arise in a comparison of James Bay with the Peace-Athabasca delta. The W. A. C. Bennett dam on the Peace River in British Columbia has drastically lowered water levels in the delta at the western end of Lake Athabasca in northwestern Alberta. Resulting effects on the delta (approximately one-fiftieth the size of the James Bay river basins) have endangered fish and wildlife and seriously affected 1 300 local residents dependent on fishing and trapping. More than one million dollars will be spent on the first stage of delta restoration to raise water levels in an attempt to reverse ecological damage. In the fall of 1971, Environment Minister Jack Davis blamed the situation on "narrow provincialism and our haste to produce energy with little or no regard for the future."

From: *The James Bay Power Proposal,* by Valanne Glooschenko, 1974

For about an hour and a half we sat on the rock on the edge of the great river. Job Bearskin talked about this person, this river, which had always helped the Indian so much. About its clean, good taste. About its good-tasting fish. About the many places he could camp along its shores. About the vegetation on the banks where the animals liked to feed and were easy to find and kill for food. About its utility as a highway, helpful to the Indian when he wanted to travel up and down the country. Nothing, in Job's experience, had ever been so helpful to the Indian as this river.

"They are robbing the land from us, the owners of the land. I am worrying and wondering about that all the time. There is going to be a lot more destruction, I feel. It is only beginning." . . . He bent down to pick up an exposed root of a small tree, decimated, stripped, raw. "They are killing the roots, and in my opinion nothing will grow here again. This is the way it's going to be. The white man is only thinking of himself. Many people are saying that. The white men are not even thinking about the land they are destroying, they are thinking only of money."

From: *Strangers Devour the Land*, by Boyce Richardson, 1977

10.

The Cree Camp

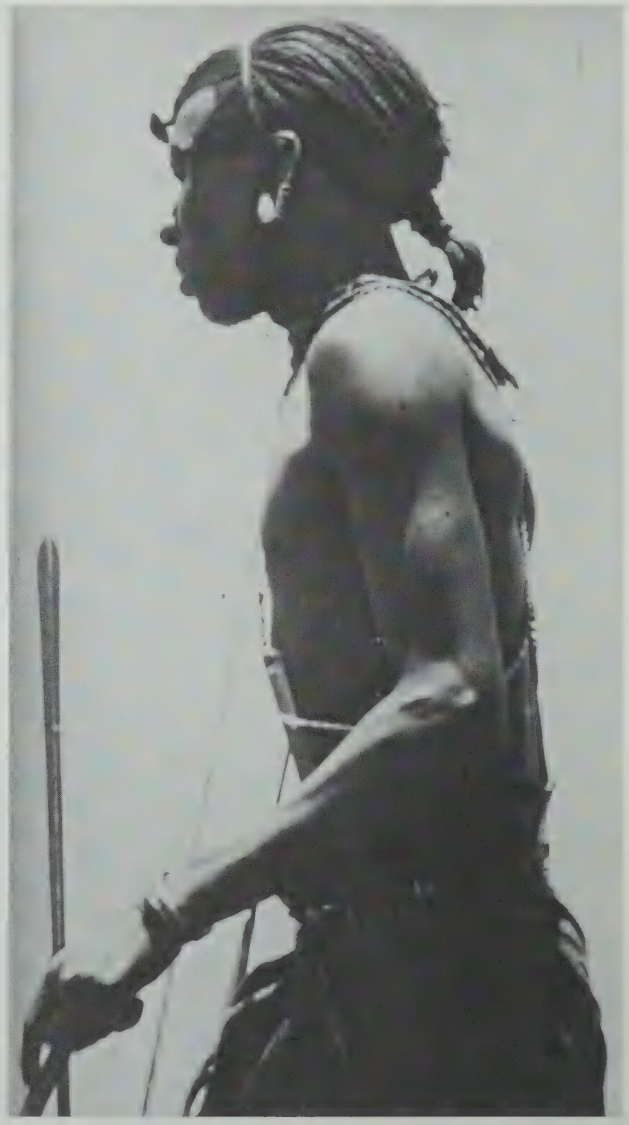
The hunting camps are astonishing, for everything in them is handmade. Although the hunting families are submerged in the Canadian winter, to them it is not a harsh environment but the very life that sustains them. The hunter splits the logs and chooses the boughs from which he will make his house. The walls are tightly packed and insulated with moss; boughs are bent over to support the canvas roof. The stove is made from an old can; the chimney is shaped from a piece of tin. The wood for the fire is gathered, sawed, and stacked before the door in piles designed to break the winter winds. A network of stripped logs is strung under the roof, somewhat like rafters, from which all sorts of things are hung during the long winter. Pliable tamarack boughs are bent into circular frames on which the beaver skins are stretched and dried. The snowshoes which are still the hunter's only means of transportation in the bush during the winter are laboriously bent into shape and strung with moose hide. The result is remarkably beautiful — the James Bay Cree showshoe. It has never found its way into the shops of the south because it is made only when needed. The sled the hunter pulls behind him also is handmade — many still make the runners from a mixture of ice and mud — and so is the snow shovel. Some of the clothing, especially the moccasins, is made from moose hides, prepared by the women according to a traditional and laborious process which involves many scrapings, soaking, drying, and finally a smoking over a fire that comes from a particular type of standing dead wood, the gathering of which is itself a major operation. On top of all that, the hunter raises his children in the arts of their ancestors — the arts of survival, the only ones which had any significance for them in their traditional lives — and catches most of his own food. Around all the camps hang bones of various kinds, the means by which the hunters show their respect for the animals. At one of the camps I visited, bear bones had been carefully wrapped in bark and tied around the trunk of two trees. No one messes around with bear bones.

From: *Strangers Devour the Land,* by Boyce Richardson, 1977

11.

The Great Resources Robbery: Effect on Culture

The Amazon clearance and the James Bay project are only two of the developments which are destroying the environments in which adaptive societies have created unique and irreplaceable cultures. What rights do indigenous people have, or what protection, under what law? This article is a general summary of the plight of the millions caught in the path of "growth".



It is no coincidence that the last relatively intact native peoples live in some of the most remote and inhospitable corners of the globe. So hostile are the deserts, jungle forests and Arctic wastes that, until recently, no-one has grudged their inhabitants these homelands. But the relentless search for new sources of energy and raw materials is now leading to an invasion of even such once inviolate environments. Parts of the world where land title seemed superfluous—so thoroughly undesirable the land appeared—are now encroached for their oil and uranium, coal and timber. The people who live there—hunter gatherers, pastoral nomads and 'primitive' cultivators—are becoming the latest victims of the international economic system. Resources deep in their traditional territories are being literally stolen from under them.

South and South East Asian countries are developing their vast forests to satisfy western demands for high value teak and their own needs for construction timber. The Brazil government hopes that the forest and mineral resources of the Amazon Basin will be the foundation on which the industrial superstate of the 21st century will be built. Semi-arid areas in Africa are being converted into huge cattle ranches; and North America and Australia are looking to their own interiors for new reservoirs of minerals and natural gas. Multinational corporations and international development agencies are combining with governments to ensure that unproductive wilderness become cornerstones of future growth. But the impact of these huge schemes on native communities is rarely considered.

It is rare today for invasions of territory to reach genocidal proportions. Far more usual is for a cultural minority to find itself a colonised people in the most debilitating sense of the term. The resource plunderers come in, dictate the end of a traditional way of life, and 'convert' its practitioners into a cheap labour force. The native peoples' rewards from the resources on their traditional lands are minimal, if not negative.

In many South and South East Asian countries shifting cultivation has been made illegal and the tribals practising it have been forced to settle in 'forest villages'. They have become labourers harvesting the timber of their own environment for distant urban centres. . . .

It is not only native societies that are sacrificed to provide development capital for third world countries. Often the newly exploited environment is destroyed as well. Many of the desert and forest peoples have successfully adapted subsistence production to delicate ecosystems, but outsiders looking for rapid returns and unaware of the fragility of the areas have caused environmental havoc. Chronic soil erosion has resulted from excessive deforestation in India; desertification in the Sahel is due largely to ill-conceived development schemes. A repeat performance is threatened in the Kalahari as cattle ranching is pushed into ever more arid areas. Gains from taking over native environments can be very short-lived indeed.

Slowly the international community, shocked by disasters such as took place in Ethiopia and the Sahel, is becoming aware of the particular problems endured by the invasion of native peoples' habitats. . . . Recently a UN study seminar was held in Mauritius to try to indicate the principles on which alternative development planning could be based.

The Awash Valley Authority in Ethiopia, charged with integrated regional planning of a large river basin, spent ten years introducing cotton and sugar plantations before even questioning the effects these might have on the two hundred thousand nomads living there. The Food and Agriculture Organisation (FAO) of the United Nations compiles inventories as the first step in advising third world governments on forest development which make no mention of the societies living there. To the Awash Valley Authority, and many other organisations, sometimes it is the development of resources, not people, that is important.

New Dependencies

Native societies are being forced to give up their isolated and independent way of life at the fringes of nation states to become primary producers for distant centres in Lagos and London, Delhi and Detroit. In Kenya, the World Bank sees the pastoral tribes who occupy the semi-arid areas surrounding the White Highlands on which Nairobi stands, as future meat producers for the markets of Europe. High taxation, the introduction of consumer goods, new sources of water, credit (and therefore debt) are being used to 'encourage' subsistence herders like the Masai, Samburu

and Turkana to become commercial ranchers. The process is in its infancy, but at the moment the nomads are receiving very low prices for their cattle and all the signs are that they will become dependent on the fluctuating demands of distant countries for their livelihoods. The multinational monopolies who own the feedlots are creaming off the lion's share of the profits.

It is not only the pastoralists who can expect to suffer. The settled rural poor of the highlands also lose out because the cattle are fattened on maize—their staple diet. A curious solution has been envisaged. A research station North West of Nairobi run by an international agency has been trying to overcome the problem by looking for a sorghum that is as good as cattle feed but unpalatable to humans. If they succeed, thousands of acres currently under maize will in the future be planted to a crop that does not excite local envy.

Only the naive romantic would suggest that the Masai or any other similar cultural minority can continue their traditional subsistence production uninterrupted in areas that could make enormous contributions to national development. Third World countries are eager to import expensive industrial technology, and sometimes food, for rapidly rising populations. Developed countries want to become as independent as possible of foreign supplies of oil and minerals. Both place too high a value on the resources located in the native peoples' traditional territory for them to be left alone.

An extreme way of resolving this conflict between native peoples and the national development of resources is simply to wipe out whole groups of unfortunates who happen to be in the way. A recent notorious case of such a policy being carried out was against some of the Ache Indians in Paraguay. The nastiest aspect of this policy is that if the job is done thoroughly, there is no-one left either to complain, or to be complained for. The fear of genocide—particularly against small tribes that have hardly been contacted—has prompted a call for reservations to protect these peoples' land rights and their cultures. But even if the land-grabbing process can be temporarily contained, the problem is to establish some system of rights whereby they can have some say in their own affairs. . . .

The Portents

There are one or two hopeful portents. A few countries have experimented with integrating native peoples in ways that allow them to play a full and equal part in national affairs, and Eskimo, Indian and Aboriginal groups have managed to keep control of some of their traditional resources. In Canada in 1972 the Trudeau government came under continual pressure from native groups supported by radical activists and a groundswell of liberal opinion, and recognised in principle the right of native title to traditional lands. As a result, 60% of Canada is now potentially claimable by its original inhabitants, and educated, organised groups like *Inuit Tapiriksat* (Eskimo Brotherhood) are renegotiating treaties and arranging favourable contracts with government departments and mining companies.

Such renegotiation is possible in Canada and the USA because the 19th century North America solution to the 'native problem' was to designate reservations where their culture was preserved and their right to certain restricted lands was recognised. It is unlikely however that treaties setting up similar special areas will be signed by newly independent countries striving to build integrated nation states. The best that can be hoped is that some nations will at least go as far as to pay formal respect to the rights of their cultural minorities. Both India and Brazil recognise the inalienable land rights of tribal groups under the constitution—hardly fail-safe, but a protection of sorts. It

would be encouraging if more African countries would follow the example of Botswana, which has recognised the peculiar predicament of the Basarwa, or Bushman, and set up a special department of government to protect the rights to resources of traditional hunting groups. It is clear that where similar rights are not protected now, there is little chance of maintaining control over resources.

The UN seminar in Mauritius was a useful first step in confronting third world government officials with the special social and environmental problems in development planning for native societies, and examining certain alternatives:

- Educate them to participate in and control the development of their traditional environments, as in the forest communes of China, in order to meet national objectives without major disruption from outsiders.
- Minimise the impact of development schemes by building on existing land-use practises rather than replacing them.
- Give proper consideration to ecological factors in arid areas to avoid environmental disaster by overgrazing.

Such alternatives may be attractive, but it is clearly useless to consider them unless national decision-makers are genuinely prepared to recognise the fundamental right of native peoples to some degree of control over their own environments. . . .

From: *The New Internationalist*, 1979

Questions for Review

This book is intended to be used with the reader's guide in which questions and activities clarify the content and ideas of each of the readings. The guide is intended for use either as a teaching aid or as a learning resource for the students.

However, another option is presented in the review questions suggested here which are intended to survey the key elements of the issues as preparation for the seminar debate which culminates the study.

These review questions may be assigned to individual students, or to groups, or to the class as a whole and may be answered in the form of discussion or a written presentation.

All student presentations should be accompanied where possible by maps, drawings, diagrams, models, etc. or even through creative writing or role playing if students should see it as appropriate.

All the readings should be assessed for possible bias in viewpoint. Students should understand that the basic coverage of the issue in these readings should be supplemented by further research from books, magazines and newspapers. Relevant, new information gathered by the student should be added to a class file on the issue under study so that resource information is constantly updated. A selection of up-to-date related documents in edited version is also available from Inter Pares, 205 Pretoria Avenue, Ottawa, Ontario, K1S 1X1 for a nominal fee to cover handling.

I THE VANISHING RAIN FOREST

1. Outline some of the general concerns of conservationists and scientists.
2. Give an account of the development now taking place in the Amazon Basin. Explain the reasons for the development from the point of view of the government of Brazil.
3. What is meant by describing the Jivaro as one of the 'adaptive' societies? What, if anything, can modern man learn from Amazonian Indians?
4. Sum up the arguments for and against the development of Amazonia. Is the future of this region a global concern, or the business of those Latin American countries who share its territory? Explain your answer.

II THE SEARCH FOR HYDRO-ELECTRIC POWER

1. Describe and illustrate how hydro-electric dams work. Compare their efficiency as a power source with others, such as nuclear energy or fossil fuel.

2. The Cree of James Bay, like other native peoples across Canada, claim to own their land. Do you agree with them? Explain your answer. What can we learn, if anything, from the Cree that can help us to make decisions about future development?

3. In August 1979 the first James Bay project was officially opened. Using other resources of information, assess the course of the project, the settlement made with the Crees, and its chances for fulfilling the promise with which it was built. Compare the pressures for development, the political decision-making, and the social and environmental effects of the James Bay and the Amazonian developments.

The Seminar Questions

The readings in this booklet and the questions (in reader's guide and review section) have been selected to provide a broad basis of information and opinion which can lead to the formulation of a point of view — a taking of sides — in a general and wide ranging debate arising from the issue.

These two 'seminar questions' are so general as to allow a wide spectrum of opinion — and students should decide on the method of attack — either informed debate or written and well-documented presentations supporting one point of view, and exploring the implications of the issue.

1. *To what extent do individual nations have the right to effect environmental change with global impacts?*

2. *In a technological world is there a place for indigenous cultures?*

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The producers of this book would like to thank the consultants of the Ottawa and the Carleton Boards of Education who offered advice and evaluation at a critical stage in production. Our thanks also to the Canadian International Development Agency for their support and to the staff of Inter Pares, Ottawa.

Photocredits

Page 4. Rainforest: Dr. Rolfe Wesche

5. Jungle vegetation: Brazilian Government photograph

15. Bulldozers in the jungle: Wesche

17. Diagram from *South America* by Gary Birchall, Fitzhenry & Whiteside, Don Mills, Ontario

19. Urban poor in a rain forest clearing: Wesche

21. New Amazonian village: Wesche

25. Amazonian Indian tribesmen: William Toye

27, 31. Hydro dam: James Bay Power Corporation

36, 41 and 42. James Bay and Cree of James Bay: Information Canada and James Bay Power Corporation

38. Environmental research: James Bay Power Corporation

44. Masai tribesman: K. Hayman

47. Bolivian fisherman: ILO photograph

Many of the readings were published before conversion to the metric system.
Instead of extensive corrections, we include this conversion table.

1 foot = .304 8 m
1 mile = 1.609 km
1 mile^2 = 2.589 km^2
1 acre = .404 ha
1 ton = 907 kg
30 F = 16.6 C

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Developed by Inter Pares
Published by Teacher's Press Ltd. (Ottawa)

Distributed by
Fitzhenry and Whiteside Ltd.,
Don Mills, Ontario